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**BIONICS AND BIOCYBERNETICS**

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Bionics and Biocybernetics

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## FOREWORD

This report has been prepared in response to the "Bionics and Biocybernetics" part of ATD Work Assignment No. 108 and is based on 392 references from Soviet open-source literature covering the period 1965--1968. The size of the report is largely due to three unusual publications: 1) Problems of Bionics, 2) Problems of Neurocybernetics (Materials of the Second All-Union Conference). 3) Problems of Neurocybernetics (Materials of the Third All-Union Conference). Abstracts from these three sources (accounting for more than 80% of the total material in the report) have been included to give a retrospective coverage and to provide specialists in the biomedical community with some indication of the scope of the Soviet effort in bionics and biocybernetics.

The report consists of two parts: a commentary and 392 abstracts divided into 12 sections and sub-sections. The reference numbers in the commentary cite the consecutively-numbered abstracts grouped at the end of the report. Each section and sub-section of abstracts is arranged alphabetically by author.

An author index is also included at the end of the report.

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## PART I. COMMENTARY

### Introductory Remarks

A great bulk of the material on which this report is based comes from three basic sources: Problems of Bionics, issued by the Scientific Council on the Complex Problem "Cybernetics," Academy of Sciences, USSR and published in 1967, and two issues of a publication entitled Problems of Neurocybernetics (Proceedings of the Second and Third All-Union Conferences on Neurocybernetics, held in Rostov-on-Don in 1965 and 1967).

The book Problems of Bionics includes 98 papers by various authors. Problems of Neurocybernetics (Third Conference) includes more than 250 papers, Problems of Neurocybernetics (Second Conference), over 50 papers. The material taken from these three sources, in addition to references from other sources, reflects the growing and widespread interest of many Soviet scientists in the closely related fields of bionics and biocybernetics.

### BIOLOGICAL MODELING

#### Human Sensory Processes

G. A. Aminev [1], in a report on the discriminatory capacity of the human taste analyzer, discusses the perception and separation of stimuli which are significant or "useful," as he puts it, from interfering or extraneous stimuli. The subjects in his experimentation had to taste various solutions with different concentrations and combinations of salt and sugar. Their task was to decide whether sugar was present in the solution. It was found that as the salt concentration increased, the sugar perception threshold also increased. After a time, however, this increase leveled off. Aminev feels that this discriminatory capacity is based on adaptation to extraneous signals and partial inactivation of reception. The complex code, on which this inactivation is based, in his opinion needs further study.

From a study of the fixating and tracking movements of the human eye, Kh. Drishel' [4] has constructed a model of the system which controls these movements. In studying the eye's tracking of a moving object, he notes two types of motion: a smooth sliding movement, and a rapid, jerky movement. The manner in which the model reacted to rapid signals indicates that there is some sort of prediction

mechanism in the eye. The author of this article is currently involved in further study of the relationship between these two types of movement in an attempt to construct another model.

In another paper concerning eye-movement regulation [13], A. I. Lauringson has studied horizontal motion by means of a photo-optic method. He found that the eye is unable to predict certain rapid movements.

V. I. Galunov, V. V. Lyubinskaya, and L. A. Chistovich [5], in a study of motor theory of auditory signal perception, express the view that investigation of the imitation process in speech yields much more data on signal perception than the psychoacoustical method. They state there is a need for new models imitating the speech process in order to comprehensively study speech perception.

There are in this sub-section of the report, several abstracts related to human visual perception and image recognition [8, 9, 11, 12, 16, 17, 18, 20]. Yu. I. Laskevich [12] discusses two different concepts of image recognition -- texton and reon recognition. Reons designate individual units or objects and textons designate a special surface or a one- or two-dimensional field. He feels that these types of recognition are applicable in other modes of perception. Lashkevich feels that without a further study of textons, it will be difficult to understand the recognition mechanisms of ordinary images. Ye. P. Kok and I. I. Tsukkerman [9] point out that the location of specific and abstract functions of man in visual image recognition differ anatomically and suggest separate storage of specific and abstract information in the memory of computerized recognition systems. In an article on the human visual system's evaluation of image size [11], I. N. Kuznetsova states that the time required for evaluating image size is not dependent on the information content of the stimulus. She feels that image size is evaluated by a specialized set of automatic mechanisms and that this confirms the hypothesis that there exist in the visual system independent channels for recognition of form and evaluation of size. S. A. Markitanova, S. B. Rudometova and B. M. Chudinovich [16] have attempted to determine the reliability with which man recognizes visual images for the purpose of evaluating machine algorithms. N. V. Turkina [20], in her experimentation concerning identification of symbol indication, seemingly agrees with Kuznetsova [11] in that she also states that identification time does not depend on the information content or quantity of the stimulus. She, too, feels that there are in the visual system specialized automatic mechanisms for symbol identification. Ye. P. Kok [8],

in his second paper in this sub-section, discusses an extensive study of object perception disorder in patients with focal injuries of the cerebral hemispheres. He presents his conclusions concerning the participation of the right and left temporal lobes in visual processing of information.

The last paper in this sub-section, co-authored by A. V. Zav'yalov and V. I. Komissarov [23], is a study of the specific coadjustability in the activity of different sensory systems. In their opinion, the experimentation proves the existence of a system establishing a definite coadjustability of specific activity of different afferent systems, and this coadjustability provides coordination of the effectiveness of utilization of incoming information.

#### Infra-Human Sensory Processes

The majority of abstracts [25, 30, 31, 32, 35, 36, 37, 42, 45, 46, 48, 50, 51, 55] in this sub-section are related to visual physiology. Four of these abstracts [25, 30, 35, 45] deal specifically with ON and OFF responses in receptive fields of the retina. A. Bertulis, V. D. Glezer, N. B. Kostelyanets, N. F. Podvigin, and I. N. Shetalov [25] propose a hypothesis that the functional organization of a retina receptive field is determined only by the light intensity falling on a given section of the retina, i.e., that it is not preformed but is formed in the course of light stimulus action. They have constructed an electronic model of a retina based on their study. V. F. Fokin [30], in a study of the effect of rhythmic light stimulation in the center and on the periphery of the cat retina, suggests the presence of multichanneling on the retinal level in the organization of the visual analyzer. N. B. Kostelyantes and N. F. Podvigin, who co-authored one article [25] with other writers dealing with the receptive ON-field of a retina and its model, have both presented papers of their own on retinal receptive fields [35, 45]. Podvigin [45] discusses reasons for differences in the behavior of the alpha and beta waves of the electroretinogram and their importance in understanding mechanisms of the on and off systems of the retina.

There are six abstracts [27, 28, 33, 41, 43, 52] in this sub-section related to conditioned reflexes and behavior patterns in animals. N. A. Chichvarina, with N. A. Dudkina, N. G. Yaremenko, and V. N. Malozemova, [27, 28] presented two papers at the same conference on the formation in rats of algorithms for decision-making in information situations. Two of the papers here [33, 41] deal with reflex activity (complex and defense reflex

systems) in rabbits and rats. The last two abstracts [43, 52] concern conditioned reflexes in experiments with probability reinforcement.

Three other abstracts [34, 38, 40] of interest are studies in olfaction and chemoreception in fish and frogs.

#### Modeling of Sensory Systems and Physiological Functions

The 37 abstracts on this subject deal with three basic areas: 1) modeling of visual functions; 2) the study of joint and muscle mechanisms for purposes of modeling; and 3) the modeling of perceptual and sensory systems. There are eight abstracts devoted to modeling of visual functions [79, 82, 83, 86, 87, 90, 92, 94]. I. A. Shevelev [82] discusses one of the most important operations of signal discrimination in the visual system: temporary peaking as a signal is transmitted from the lowest to the highest level of the visual analyzer. Related aspects of modeling synchronization of initial afferent flow in the visual system are also discussed. His study indicates an increase in the number of responding elements at the higher levels of the visual system (neurons of the lateral geniculate body, the visual cortex) and increased synchronization of their firing. There are two papers on modeling of color vision. D. A. Shklover [83] has devised a mathematical model of color recognition for explaining the mechanism of color vision. N. G. Volkov and V. K. Lyapidevskiy [90], affiliated with the Moscow Engineering and Physical Institute, describe a model (with two photo cells) for simulating color vision defects including deutanopia, protanopia and tritanopia. V. M. Ukhin [86] discusses functional features of human binocular vision as related to the modeling of nerve integration in the human visual system. Mathematical simulation of the spatial properties of a receptive field is discussed by V. G. Uvarov [87] and a mathematical model of the oculomotor apparatus is described; this model was displayed at the Physics Pavilion of the Exhibition of Achievements of the National Economy of the USSR [94].

There are five abstracts concerning research directed toward the modeling of joint and muscle mechanisms [59, 60, 67, 69, 81]. P. P. Gambaryan [67] discusses the various gaits of quadrupeds in an attempt to fit these motions into the mechanics of lever-driven machines. Another paper [59] is a study of the joints of the extremities of mammals as damping devices. Among the six abstracts [58, 65, 71, 76, 77, 84,] related to the modeling of perceptual and sensory systems, an article by Ye. V. Baybikov [58] describes an

electronic circuit which closely simulates the action of actual sensory receptors and which can be used for studies of sensory phenomena and for developing artificial sensory receptors. V. Ya. Dymerskiy and Ya. Ya. Belik [65] describe models of visual perception which can be used for psychological evaluation of a field of vision suitable for control of certain kinds of moving systems. In an article [71] by A. B. Kogan, G. V. Goncharova, Ye. V. Kompaneyets, and V. G. Siyusar', an attempt is made to determine the extent to which electronic models of visual and auditory perception can match natural perception of the external world. Their experimentation gave evidence that the signal meaning of a light or sound stimulus and an electrical stimulus are identical, and that it would seem possible to produce adequate afferentation by direct electrical stimulation of the analyzer systems. In an investigation [84] based on determining the nature of interactions between conditionally selected regions of the brain, A. I. Stavitskiy presents a discrete analog model of a sensory system. The most distinctive feature of this model is its capacity for carrying out the systematic multichannel "interrogation" of a large number of nonlinear elements which have a sensory input including both discrete and continuous signals.

#### NEURONS IN BIONICS AND BIOCYBERNETICS

##### The Study of Neurons, Neuron Organization, and Neural Networks

A. B. Kogan, who is apparently affiliated with Rostov University [111], is the editor-in-chief of Problems of Neurocybernetics (Materials of the Second Inter-University Conference on Neurocybernetics, 30 September-5 October 1965), and also of Problems of Neurocybernetics (Condensed Reports of the Third All-Union Conference on Neurocybernetics, 7-12 September 1967). Abstracts of a great number of the papers presented at these conferences are included in this report. Kogan himself has written a number of papers which the reader will encounter throughout this report. In the present subsection there are abstracts of 4 of his papers [110, 111, 112, 113]. The first paper [110] examines the organization of nerve cells in neuron networks. In another paper, [111] Kogan and I. V. Popov (also affiliated with Rostov University) analyze the action of a Poisson flow of impulses through one synapse for the case of background activity. The third paper [112], co-authored by Kogan and B. M. Vladimirskiy, is also concerned with neuron background

activity in the higher sections of the brain. Kogan and Vladimirskiy, together with S. L. Zaguskin [113], are again co-authors of a paper which attempts to develop mathematical approaches to the analysis of probabilities in the spatial interrelation of intracellular microstructures.

The majority of the remaining abstracts in this subsection can be separated into the following five areas: 1) nerve-cell impulse activity; 2) functional organization of neurons; 3) neural stimulation and inhibition processes; 4) synaptic processes and effects; and 5) aspects of neuron interaction and relationships. There are eleven abstracts related to nerve-cell impulse activity [96, 99, 104, 130, 133, 137, 143, 151, 153, 155, 156]. There are papers in this subsection by O. G. Chorayan [96, 130, 131, ], and I. V. Popov [111, 133, 153, ], both of whom are affiliated with Rostov University. It can be assumed that both Chorayan and Popov work closely with A. B. Kogan [111], who is also at Rostov University. In a study [96] of the statistical characteristics of impulse activity of the respiratory neurons of the frog's medulla oblongata, A. M. Berezovskiy, L. D. Karpenko, and O. G. Chorayan established that there is a definite connection between the duration of bundle impulse activity, the interimpulse interval in the bundle, and the duration of the interbundle interval. Another study of impulse activity by A. A. Genkin and N. N. Vasilevskiy [104] deals with the relationship of peak activity and asymmetry of electrocorticographic phase durations. Chorayan and Yu. I. Petunin [130], who is affiliated with Voronezh University, have undertaken a study to explain changes in random processes, and to describe neuron impulse activity in the presence and absence of stimuli. A paper by G. I. Shul'gina [137] analyzes background impulse activity of neurons in the development of conditioned reflexes. Another paper dealing with background impulse activity by A. G. Sukhov [143], affiliated with the Laboratory of Biophysics of Rostov University [142], investigates the reactions of neurons to a standard stimulus under spontaneous or artificial change in the frequency of background activity. In the ten papers concerned with functional organization of neurons, [95, 98, 101, 107, 108, 110, 136, 141, 142, 145], the names of L. D. Karpenko and O. G. Chorayan [107], and A. G. Sukhov [142], are again encountered. Karpenko and Chorayan have co-authored a work on the functional organization of central respiratory neurons in amphibians and Sukhov has written an article concerning the study of neuron organization in focal epileptiform discharges in order to determine the relationships between neurons under various conditions of CNS activity. There are two more papers related to the functional organization of the medullary respiratory center, one by A. M. Karpukhina [108] and the other by V. A. Safonov and R. A. Durinyan [136].

There are a total of seven papers dealing with neural stimulatory and inhibitory processes [114, 115, 116, 127, 129, 138, 144]. All seven of these papers were presented at the Third All-Union Conference on Neurocybernetics and appeared in Problems of Neurocybernetics, the published reports from this conference. In an investigation of stimulatory and inhibitory periods in the reactions of neurons of an isolated cortical stria, I. N. Kondrat'yeva and G. A. El'kina [114] established that the same types of neuron reactions which appeared in the intact cortex in response to afferent stimuli also appeared in response to stimuli applied to deep layers of the cortex. From their experimentation, new proof was obtained that the inhibitory period and the period of subnormal responsiveness in the recovery cycle are caused by an active process and not by refractivity. The recovery following the inhibitory interval and the period of subnormality indicate the probable presence in the cortex itself of the elements inducing inhibitory reactions. A report by A. B. Kotova [116] gives a formalized mathematical theory of nerve-cell excitation, considering the dynamics of ion conductivities of the membrane. This mathematical investigation permits the determination of certain mechanisms controlling shifts in threshold potentials. Specific and nonspecific neuron inhibition in the visual cortex of the rabbit is discussed in a report by V. G. Skrebitskiy [138]. This preliminary data indicates that nonspecific inhibition is not accompanied by development of an inhibitory postsynaptic potential, but is accompanied by suppression of both impulse discharges and inhibitory postsynaptic components of light responses.

There are a total of six abstracts [106, 109, 119, 120, 134, 150] concerned with synaptic processes and effects. One of them, by V. Ya. Pyatigorskiy [134], is an attempt to verify the hypothesis that receptor elements cause spontaneous discharges in neurons of the dorsal spinocerebellar tract. The experiments demonstrated that the spontaneous activity of these neurons is determined by the nature of afferent impulsion and by the weight value of the synaptic input through which it enters. In a study of neuron reaction, synaptic mechanisms of the motor zone of the cortex to signals of different sensory modalities, L. L. Voronin and L. I. Tanengol'ts [150] state that when two stimuli are presented with a small interval between them, the response to the second stimulus is blocked when the interval is less than a certain value, regardless of the relation of the modalities of the stimuli. They discovered that this blocking is not related to postsynaptic inhibition in the cells, but to the blocking of the second signal en route to the cells.

Among the four papers related to aspects of neuron interaction and relationships [125, 146, 148, 149], is a study by A. I. Nadvodnyuk and S. A. Kuznetsov [125] of neuron interaction in the snail's subpharyngeal ganglion demonstrating the presence of intermediate neurons and associated complexes of nerve cells in which the rhythm of a leading neuron controls the activity of at least four dependent nerve cells.

Functional interneuronal relationships at the highest analyzer levels in the cerebral cortex were investigated by I. A. Vladimirova and V. M. Storozhuk [149] to elucidate the basic principles of how the nervous system analyzes images of the external world. The authors state that although peripheral sections of the analyzers are quite specialized and differentiated, their cortical sections are similar in structure and function. Thus they hypothesize that information processing in the neuron network of the projective zones of different analyzers can be based on these same general principles. The paper represents a study of the functional properties of neurons and interneuronal relationships in the first projective zone of the cortex of an anesthetized animal. From the study, the authors conclude that neurons of the first projective zone are capable of preserving signal traces for a short time and also of analyzing signals arriving directly from the peripheral nervous system.

#### Neuron and Neural Network Modeling

Each of the 34 abstracted papers in this subsection deals directly with some aspect of the modeling of neurons, neuron function, and neural networks. There are two papers by N. A. Aladzhalova [158, 159], who is affiliated with the Institute of Biophysics of the Soviet Academy of Sciences in Moscow. Both papers deal with modeling of signal recognition on the dendrite level. Both papers indicate that the flow of information in the dendrites possibly stimulates further development of synapse and dendrite processes, which perhaps considerably increases the elasticity and potentialities of memory.

In two reports, N. V. Pozin [171, 176] of the Soviet Academy of Sciences' Institute of Automation and Telemechanics (technical cybernetics) in Moscow, considers the multilayer modeling of neuron networks. In one report, the author (using known information about neurons and neuron interactions) examines a hypothetical mechanism for the search for and marking of connections between two centers in a model of a uniform neuron layer.

An hypothesis concerning an increase in the strength of the connections between simultaneously excited neurons was developed as the basis of the marking mechanism. In Pozin's third paper [182], representations of elementary operations and functions of neuron logic are systematized using geometric interpretation.

There are two papers by A. B. Kogan [172, 173] of Rostov University, co-authored by Ye. K. Chaknakhyan, A. I. Samarin, G. V. Shcherbakova, and P. T. Sokolenko. One paper deals with the feasibility of constructing a neuron model approximating a real neuron. The other paper concerns materials for the study of mechanisms forming temporary connections in neuron networks. The experiments in this study confirmed the metabolic basis of processes of formation of new interneuronal connections by determining the "chemical" magnitude of their temperature coefficient. The modeling of synaptic transmission is discussed by L. V. Idel's and I. T. Kruglikov [168] in a paper which describes the analysis with a mathematical model of synaptic processes during passage of a complex afferent signal. In another paper [169], Idel's and Kruglikov, along with Ye. P. Motanyy, present a mathematical model of processes taking place in active and passive elements of a homogeneous afferent structure during passage of a complex signal. N. N. Vasilevskiy [190] of the Institute of Experimental Medicine of the Soviet Academy of Medical Sciences in Leningrad studies the neuronal mechanism of orientation reflexes and temporary connections in the cerebral cortex and some problems related to their modeling.

#### PROBLEMS OF MODELING HIGHER NERVOUS ACTIVITY

In this section there are 83 abstracted papers concerned with the study of such higher nervous activities as the memory process, decision-making, thought processes, etc., and problems related to their modeling. Included here are a large number of reports devoted to heuristics and the modeling of human heuristic activity.

The name of N. M. Amosov is often encountered in the area of modeling of higher nervous activity; he is a Corresponding Member of the Soviet Academy of Medical Sciences and also served as the Scientific Director of a seminar entitled "Certain Problems of Biocybernetics and the Application of Electronics in Biology and Medic'ne" [193]. He works at the Institute of Cybernetics of the Ukrainian Academy of Sciences [194]. In one of his papers [192], Amosov describes an algorithm for a structural model of psychic functions.

Amosov, A. M. Kasatkin, and L. M. Kasatkina, who are also affiliated with the Institute of Cybernetics of the Ukrainian Academy of Sciences [194] are the authors of a paper on the heuristic modeling of behavior. They describe at length the structure of their modeling system, which is a multistage organization of a number of different models. Programs of the system which they describe can approximately model certain programs of higher animal and human psyches. Three other reports by Kasatkin and Kasatkina [220, 221, 222] concern the modeling of purposeful behavior, the modeling of motor behavior, and heuristic modeling of some information-processing functions of the brain. Their heuristic model is based on N. M. Amosov's hypotheses.

Another author, Yu. G. Antonov [195], who is also affiliated with the Institute of Cybernetics of the Ukrainian Academy of Sciences discusses indeterminism and determinism in the activity of cortical analyzers. He concludes from his study that both the elements of the cortical analyzers (simple neuron blocks) and the analyzer itself pass from one determinism to the other through a zone of indeterminism. I. V. Bushara [207] discusses problems of heuristics in form recognition. He defines heuristics as an outgrowth of cybernetics and psychology which deals with the solution of their problems and which seeks eventually to create an artificial brain. He states that there are psychological laboratories at Moscow University which are involved in the study of heuristic processes in the mental activity of chess players. It is his belief that the construction of a computer which could find for itself an appropriate planning method is feasible.

In an empirical investigation of the processes of fixing and reproducing information on which the memory mechanism is based, O. G. Chorayan and Ye. Ya. Gil'man [210] propose a model of the memory mechanism which makes it possible to explain the relationship of the volume of short-term memory to the length of the remembered sequence and to calculate the volume of long-term memory. L. P. Krayzmer [227] analyzes the functioning of human memory and indicates the direction of research for producing computer memories which operate on the same principle as human memory. He states that future studies of memory in which mathematical models and electronic circuits may prove useful should proceed at four levels: 1) the structural level which will involve large functional units; 2) the network level at which studies of the interneuronal connections would be conducted; 3) the cellular level for studies of neuronal activity and changes of state; and 4) the molecular level for defining the role of RNA. It is noted by R. I. Kruglikov

[228] in a study on the correlation of short- and long-term memory that although the memory trace changes its formation from a labile form (short-term memory) into an unusually stable form (long-term memory), the content of the memory trace does not change in this consolidation process. He feels that it is very probable that storage of the engram at various stages of its formation is linked with the activity of the same neuron systems, in spite of differences in short- and long-term memory mechanisms. On the basis of certain principles given in his report, V. A. Kuz'menko [230] of the Institute of Normal and Pathological Physiology of the Soviet Academy of Medical Sciences in Moscow, proposes a simple automatic model of voluntary behavior in a simple environment. The model consists of four units: an afferent unit, an efferent unit, a motivation unit, and a memory unit. This model is capable of adjusting to the environment after several contacts. The degree of learning increases with transition from orientation activity to stereotype activity.

There are five abstracts of papers [236, 237, 238, 239, 240] by A. V. Napalkov of Moscow State University, in which he studies information processes, problem solving, and heuristic activities in the human organism. One paper by Napalkov, N. N. Rodman, and B. A. Dashevskiy, who are also affiliated with Moscow University, concerns heuristic programs as a basis for the operation of self-organizing and self-teaching systems. The authors mention that work in this area is being done at the Laboratory of Information Processes of Moscow University. Essentially, the article is a review and appraisal of theories and methods developed in the area of heuristic programming. The authors conclude that at present, there is little likelihood of detailed concurrence of cybernetic theory with the mechanisms of the brain that are being studied.

In a report on difficulties in the so-called area of "psychonics", D. A. Pospelov [252] defines the term as the science of investigating the psychic activity of man and animals with the purpose of using the results in technological systems. Pospelov indicates what he feels are the three most important problems of psychonics: 1) creation of an external environment model in a machine; 2) decision-making; and 3) modeling of personality. He feels that the development of personality theory has practical application in the design of control systems which could have certain "subjectivity" in solving problems, especially problems in conflict situations. V. N. Pushkin [254, 255], who is working at the Institute of Psychology of the Academy of Pedagogical Sciences in Moscow, examines the problem of neuron function of a heuristic automaton. He has analyzed the function of

neurons as units for construction of cybernetic systems and presents a hypothesis which makes it possible to examine the process of creative thought. In another article by Pushkin and Yu. M. Lopushkina [255] (also of the Institute of Psychology), intracortical automatic regulation and human heuristic activity are discussed. The authors feel that there exists in the problem-solving process a regulation of the collection of information concerning conditions of the given problem although the individual is not aware of this regulation. They discuss the role of the cortex as a regulator of the organism and its behavior in external surroundings, or as a self-regulating unit of the system, and then mention the functioning of the intracortical regulator. Their hypothesis is that results of this problem-solving process (which has to be expressed in the code of intracortical regulation) cannot be understood until developed within the model and until interaction of the regulator and the controlled object has begun.

#### PROBLEMS OF TRANSMISSION, PROCESSING, AND ENCODING OF INFORMATION IN THE LIVING ORGANISM

In this section, the subject of processing and transmitting of information along a nerve fiber is dealt with in detail by two different authors - L. M. Gambaryan and Yu. M. Gasparyan [281, 282]. Both are associated with the Laboratory of Neurobionics of the Armenian Academy of Sciences in Yerevan; however, an older source [285] states Gasparyan's affiliation as the Yerevan Polytechnical Institute. These authors, taking into account certain data concerning both the theory of discrete conduction and the nodes of Ranvier, have considered the problem of information transmission probability along a nerve fiber [281]. They point out that information is carried, not by a single nerve impulse, but by a bunch of successive impulses. With a bunch of successive neural impulses, then, the probability of information transmission along a receptor-fiber system sharply increases. Despite the low reliability of the single fiber, the whole system proves to be very reliable. Four other papers [282, 283, 284, 285,] by the same two men deal essentially with the same subject.

I. A. Lyubinskiy and N. V. Pozin [293, 294] describe a multi-layer model of afferent information processing in the auditory system. The model is based on the hypothesis that information concerning the frequency and intensity of an auditory signal is processed in the neuronal layers of the

auditory analyzer according to a principle whereby quantitative characteristics are converted into coordinates of the excited neuronal regions. In a paper [311] on the statistical characteristics of the transmission functions of neurons, N. N. Vasilevskiy of the Institute of Experimental Medicine of the Academy of Medical Sciences in Leningrad, states that the most important part of the problem of studying mechanisms for the processing and transmitting of information in neural structures is the permeability characteristic of individual neurons. Permeability of projective neurons of the somatosensory cortex with local receptive fields reacting to rhythmic tactile stimulation of cutaneous receptors, was studied in detail. The method used for statistical analysis of permeability determines precisely which frequencies of tactile stimuli are reproduced by the cells, and what average level of impulse activity corresponds to the reproduced rhythm of stimulation. The author discovered that rapidly adapting neurons of the cortical projective zone of the cutaneous analyzer have different spectral characteristics of perceptually reproduced stimulatory rhythms.

#### STUDIES IN ANIMAL ORIENTATION, NAVIGATION, LOCATION, AND COMMUNICATION

S. Ye. Kleynenberg and N. V. Kokshayskiy [322] point out that even though effective solutions for economic engineering problems can be found everywhere in nature, it would be a mistake to copy nature indiscriminately, because, due to the strong temperature limitations of a living organism, man-made power plants are much superior in terms of output. Several problems of biological aero- and hydrodynamics are discussed in their article. The authors feel that the purpose of bionics is to reveal the physical character of devices used by nature to achieve high but minimal power-consuming locomotive effects, and to express the results in a precise mathematical and physical language. There are a total of 23 abstracted papers in this section concerning such problems as the echolocation mechanisms of bats, chemoreception in fish, the discriminatory capacity of insects to differentiate figure outlines, biohydrodynamics and bioenergetics in aquatic animals, and so forth. A team of authors — V. I. Bodryagin, I. A. Levchenko, L. I. Frantsevich, and I. I. Shalimov [316] — have conducted an interesting study on gray Ukrainian honeybees and the means they employ for transmitting information about

the location of a food source. The dance performed by the bee on the honeycomb is described. The form of the dance is circular -- first in a clockwise, then in a counter-clockwise direction. At a certain point, the bee begins to sway rapidly from side to side. The authors state that there is a direct proportional relationship between the number of sways and the distance to the food source. Other features of this dance are analyzed and the author's hypotheses concerning the significance of the movements involved are presented. It is indicated in several of the abstracts in the present section that the conclusions reached are somewhat tentative.

#### BIOPOENTIALS AND BIOELECTRIC CONTROL SYSTEM STUDIES

It can be seen in this report that a great number of scientists are presently working in the area of biocybernetic studies at the Institute of Cybernetics of the Ukrainian Academy of Sciences. For example, L. S. Aleyev and S. G. Bunimovich [337] of this Institute have constructed a functioning model of a bioelectric control system with feedback for relearning complex motor actions in pathological conditions. The authors' studies were conducted at the Neurology Clinic of the Kiev Medical Institute. Their experiments indicate that the law of variation of the summary neuromyogram's mean value can be used as a controlling signal in multichannel systems. Amosov [338], also of the Institute of Cybernetics, discusses simulation as an instrument of prognosis and control, considering systems involving the interaction of society with the material world and the world of nature. Descriptions of two control devices [344, 350], both of which have been announced by the Central Scientific Research Institute of Application and Construction of Prostheses in Moscow are among the abstracts in this section. A study of the principles of control of machines and living organisms by muscular biopotentials by A. Moretskiy, Yu. Ekel', and K. Fidelyus [346] indicates that detailed studies of stimulus parameters show that coding of muscular biopotentials is superior to direct tapping of biopotentials as a physiological control method.

## BIOLOGICAL REGULATORY SYSTEMS

A. Krauklis [361], Doctor of Medical Sciences at the Institute of Experimental and Clinical Medicine in Riga, discusses certain regulatory mechanisms and processes in the CNS which influence the activity level and information processing rate of the brain. He states that there are three main types of CNS autoregulation, and mentions that if humans can learn how to voluntarily bring these regulatory mechanisms into play, the functional state and operation of the central nervous system can be regulated to some extent at will. Twenty-two abstracts are concerned with several different kinds of biological regulatory processes, and with the modeling of these processes. N. M. Amosov and others [354] have analyzed a previously developed mathematical model of hemodynamics. Their analysis permits the identification of a number of characteristics which determine cardiac reactions to different effects. Although they state that there are bases for organizing a system of self-regulation of blood circulation, they do not examine them further in their paper. In a study [352] of the nature of the functional dependence of cardiac output on pressure in the right atrium, B. T. Agapov, N. A. Gorshinskaya, and L. G. Mokhort state that analysis of this dependence is important for understanding the regulatory mechanism of cardiac productivity and is essential for a quantitative description and formation of a mathematical model of cardiac function. They describe the linear and nonlinear types of dependence found in their study. A. S. Batuyev [355] points out that the morphological and physiological design of a motor analyzer still has not been clearly determined. He indicates certain factors which show that the motor analyzer is the most important cerebral apparatus for interanalyzer integration. B. A. Fomin [357], in a study of qualitative and quantitative characteristics of efferent and afferent connections of the visual cortex, found that efferent cortical dendrites terminate in the dorsal and ventral nuclei of the lateral geniculate body and also in the reticular nuclei of the diencephalon. This study makes it possible to develop a concept concerning the comparative participation of the indicated nuclei of the lateral geniculate body in the visual analyzer feedback system. Several abstracts deal with aspects of modeling the following: multichannel physiological regulators, self-regulating intra-organic systems, regulator properties of the neuromuscular transmission mechanism, and neural mechanisms involved in the regulation of cardiac function.

#### ARTIFICIAL INTELLIGENCE (PATTERN RECOGNITION, LEARNING PROGRAMS, SPECIAL DEVICES)

The team of N. M. Amosov, A. M. Kasatkin, and L. M. Kasatkina [373], all of the Institute of Cybernetics of the Ukrainian Academy of Sciences, discusses the possibility of creating an artificial intellect based on M-networks, and describes the basic theses of heuristic simulation of psychic functions with networks of elements similar to neurons. Most of these eleven abstracts deal with learning processes and programs. There are studies on the solving of information problems under complex limitations, on the general structure of self-learning recognition systems, and on pattern recognition in the absence of a learning process. Two memory devices [376, 381] are described, one of which is an optical memory unit.

The remaining nine abstracts in this last section of miscellaneous related items give some indication of how bionics and biocybernetics are developing and are constantly penetrating into many other new areas.

## PART II. ABSTRACTS

### SECTION A. BIOLOGICAL MODELLING

#### Sub-Section 1. Human Sensory Processes

1.

AUTHOR: Aminov, G. A

ORG: none

TITLE: Separation of a useful signal from noise in the taste analyzer

SOURCE: AN SSSR. Nauchnyy sovet po kompleksnoy probleme "Kibernetika". Voprosy bioniki (Problems of bionics) Moscow, Izd-vo "Nauka", 1967, 76-79

TOPIC TAGS: man, signal noise separation, gustation, adaptation

ABSTRACT: Several general neurophysiological principles employed by an organism to separate useful signals from noise are considered. A useful signal represents a complex of physiologically meaningful stimuli which are united in the afferent synthesis system and determine the nature of an organism's reaction. Noise represents a set of stimuli of the internal or external environment interfering with the perception of any of the useful signal elements, and thereby decreasing the probability of a response reaction or disturbing its adequacy. Useful signals and noise are highly important biological concepts. Thus, if the interaction of an organism with the external environment during its entire life span ( $t$ ) is expressed by ecological concepts, then the interaction of an organism with the environment at any given moment of time (for a short interval of time  $\Delta t$ ) is expressed by the concepts of useful signal and noise. Apparently, in the evolution process of the animal world the problems of insuring organisms with highly efficient means of separating useful signals from noise have to be solved. These problems have been considered extensively for the visual and auditory analyzers, but not the taste analyzer. To study the latter, a 100 cell matrix with different concentrations (0-16%) of sugar, salt and their combinations were prepared. The subjects had to decide whether sugar was present in the solution or not. A curve was plotted showing the dependence of the sugar perception threshold on salt concentration, which represented noise in this case. Tests show that with increased concentrations of salt, the thresholds of sugar perception increase, that is, the separation of useful signals curve goes up (see Fig. 1). Following adaptation of a subject to salt, the separation of useful signals curve becomes parallel to the axis of abscissa (see Fig. 1), that is, the thresholds of sugar perception with increased salt concentrations do not increase. With increased salt concentrations only, the time required for adaptation increases. It appears that an effective means of separating a useful signal from noise in the taste analyzer is adaptation to the noise and partial inactivation of reception. Such inactivation is based on a complex corrective code which requires further investigation. Orig. art. has: 3 figures.

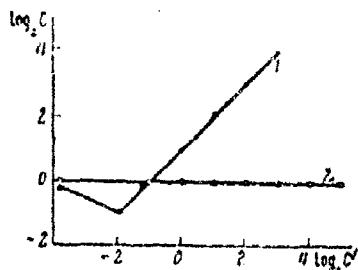


Fig. 1. Separation of useful signals from noise curve in the taste analyzer.

$C'$ —salt concentration in a solution;  
 $C$ —concentration threshold of sugar perception;  
 1—before adaptation;  
 2—after adaptation.

2.

AUTHOR: Chuyev, V. Ya.

ORG: none

TITLE: Transformation of light energy during human analysis of light

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 164

TOPIC TAGS: visual perception, light energy, probability, illumination engineering, quantum mechanics

ABSTRACT: Information calculation was performed during transmission of light energy by achromatic signals inducing a light effect. Speed of information transmission was determined by a probability approach. This speed amounted to tens of bits per second. A hypothesis was expressed on the presence of a similar mechanism during action of objective light radiation on the retina. Illumination engineering calculations led to a general opinion about the limiting number of quanta penetrating into the receptors and providing the mechanism of subjective light effect. Data are presented on the pulse nature of the process. A quantum approach to analysis of certain light phenomena in human and animal retina is planned.

3.

AUTHOR: Dolyatovskiy, V. A.; Ponomareva, I. D.; Tsepkov, G. V.

ORG: none

TITLE: Possible functional features of receptive fields

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 38-39

TOPIC TAGS: central nervous system, peripheral nervous system, information processing, neuron, signal processing, tracking control

ABSTRACT: The concentration and overlap of receptive fields makes it possible to separate elementary characteristics (such as slopes, curves, and angles) even on the level of primary neurons. Spatial coding is provided by a great number of overlapping receptive fields. The different diameters of the fields result in different receptor resolving capacities and different sensitivities. The larger diameter fields operate with small intensities and the small fields operate with large intensities. The multilayered neuron structure of the analyzers ensures the hierarchical nature of sensory processing. It can be assumed that nerve cell impulse discharges carry information about a signal located in the receptive field of the cell. Thus, if  $E_1, E_2 \dots E_n$  designate receptive fields of the primary neurons and  $f(E_1) \dots f(E_n)$  are correspondingly the level of their excitation, then formation of more complex functions, in which the characteristics of the primary neurons are independent variables, takes place in the subsequent multilayer neuron network. The most simple concept of the function of a primary neuron  $f(E_1)$  is that of its integrated activity. The receptive fields of subcortical formations and of the cortex are different in form. This means that it is possible to speak about a difference in their functions.

4.

#### CYBERNETIC STUDY OF THE FIXATING AND TRACKING MOVEMENTS OF THE HUMAN EYE

Drishel', Kh. Mezhvuzovskaya nauchnaya konferentsiya po neyrokibernetike, 2d, Rostov-on-Don, 1965. Problemy neyrokibernetiki (Problems of neurocybernetics); materialy konferentsii, v. 2. Rostov-on-Don, Izd-vo Rostovskogo univ., 1966, 151-154. AT7033546

When the eye is tracking a moving object, two types of motion are observed: a smooth sliding movement, and a rapid, jerky (staccato) movement. The latter may occur with a frequency of 400 movements per second, and last from 20 to 50 msec. These motions cannot be controlled or significantly altered.

The author created the following model of the system controlling the tracking movements of the eye.

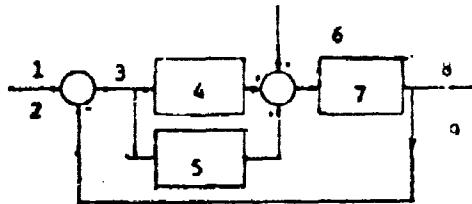


Fig. 1. Model of control system for tracking movements of the eye

1 - input; 2 - angle of object,  $x(t)$ ; 3 - error,  $\epsilon(t)$ ; 4 - staccato mechanism; 5 - smooth mechanism; 6 - stimulus; 7 - eye and muscle dynamics; 8 - output; 9 - angle of eye,  $y(t)$ .

A complex combination of both movements is used when the eye is tracking an object. The staccato movements appear to have the function of correcting the slow movements. A variety of special signals were presented to test subjects to obtain a more exact idea of how this correction is effected. When a rectangular figure was shown on an electron-beam tube, the behavior of the movement-regulating system was quasi-linear and stationary. When the signal moved more rapidly, coincidence between eye motion and signal motion decreased, indicating the presence of a prediction mechanism in the eye.

Periodic sinusoidal signals with varying frequencies and amplitudes were also used in the experiments. Generally, more staccato movements appeared as tracking ability decreased. No subsequent improvement was found which could indicate the presence of a self-teaching system.

Another signal used had a notched shape, initiating axokinetic nystagmus. In this case, interference and transformation of rhythms appeared, giving evidence of an optical regulatory mechanism which functions at its own frequency.

The system controlling eye movement is nonlinear. One problem in the study of eye movement in response to stochastic signals is the isolation of the fast movements, which appear as a consequence of nonlinear elements in the signal.

The relationship between fast and slow movements varies according to the nature of the signal. The author is now engaged in research on the functional relationships between both types of movement, with the objective of constructing a mathematical or cybernetic model. [EL]

## 5.

AUTHOR: Galunov, V. I.; Lyublinskaya, V. V.; Chistovich, L. A.

ORG: none

TITLE: Motor theory of auditory signal perception

SOURCE: AN SSSR. Nauchnyy sovet po kompleksnoy probleme "Kibernetika". Voprosy bioniki (Problems of bionics) Moscow, Izd-vo "Nauka", 1967, 65-68

TOPIC TAGS: audition, speech recognition

ABSTRACT: According to the motor theory of auditory perception, the intermediate link in the speech perception process is the transition from the auditory form of a speech signal to its motor form which represents a set of control commands necessary for pronouncing the signal. The motor theory is reduced to the hypothesis that the spatial points of speech concepts correspond to motor articulated images and that the spatial axes correspond to independent parameters of articulated movement control. Since the meaning of a perceived signal is determined for each of the motor parameters by specific processing of the acoustic information contained in the auditory image, evidently the motor parameter can be considered a function of some acoustic properties of the signal. It is natural to suppose that the space of motor characteristics is formed in the process of learning to imitate sounds. Since speech imitation of a

child is corrected and directed by adults, the structure of motor space reflects to a certain degree the system of a given language. Probably, the motor description of a speech signal in the nervous system of a polyglot or a linguistic specialist is more detailed and accurate than of a person who knows only one language. It has been established that the word is the unit used in auditory perception, and that the pitch, rhythm, duration and force of the spoken word is more important in speech perception than its phonemic form. Investigation problems of speech perception include elucidation of auditory space structure, motor space structure and transformation of the auditory form of a speech signal to its motor form. Experimental work has shown that investigating the imitation process yields much more data on signal perception than the classical psychoacoustical method. New models imitating the speech process are needed for comprehensive studies of speech perception.

## 6.

AUTHOR: Gurova, Ye. V. (Tselinograd)

ORG: none

TITLE: Asymmetry in functions of the motor analyzer in various human types of hemisphere dominance

SOURCE: Konferentsiya fiziologov Sredney Azii i Kazakhstana, 3d, Dushanbe, 1966. Materialy, Dushanbe, 1966, 120-122

TOPIC TAGS: central nervous system, sensory motor area, brain

ABSTRACT: This asymmetry was studied in 805 individuals divided into three groups; the first comprised purely right handers (dominance of the left hemisphere); the second right handers with signs of lefthandedness (partial dominance of the right) and those with left eye control (partial dominance of the right hemisphere's sensory region); the third group consisted of left handers and ambidextrous persons (retrained left handers). The aim was to determine whether dominance appears in the first signal system. The test methods applied were esthesiometry of the palm surface with a Weber compass, haptic asymmetry according to Uznadze, consisting in evaluation of the volume of two equal spheres by right and left hand simultaneously and alternately. Esthesiometric findings revealed a better differentiating capacity for location on the right for right handers and vice versa; the left hemisphere showed a higher capacity for precise differentiation. In the second test, 78% of the right handers gave correct answers as against 57.8% of left handers, in respect to evaluation of sphere size; most of the incorrect answers came from the ambidextrous. Synchronicity of the hands was 84% in pure right handers, 66.6% in those with motor signs of left handers. Incorrect coordination was seen in 81.8% of the third group. It was concluded that the execution of complex motor coordination by both hands depends on the type of dominance in the sensorimotor regions of the brain hemispheres. Only full dominance of the left hemisphere in purely right handers permits full synchronicity and symmetrical motor function of both hands.

7.

AUTHOR: Klyuzner, E. B.

ORG: none

TITLE: The reliability, noise-stability, and invariance to spatial location of external effects in receptor systems

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 64

TOPIC TAGS: man, animal signal transmission, signal reception

ABSTRACT: Multichanneled transmission of information on the magnitude of an external effect and the mutual (lateral) inhibition of receptor elements has high reliability and noise-stability. At any distribution of parameters for receptor elements and the connections between them, the total activity of receptor elements, included in certain ranges can be set close to unity. Together with increase in reliability, growth in the number of receptor elements results in small values for dispersion of the total activity of receptor elements induced by noise. A receptor system with spatial change of inhibition between elements provides invariance of total activity in relation to the spatial location of an external effect. The distribution of activity according to the set of receptor elements contains information about the configuration of the external effect.

8.

AUTHOR: Kok, Ye. P.

ORG: none

TITLE: Object perception disorder with injury in the dominant or subdominant hemisphere of man

SOURCE: AN SSSR. Nauchnyy sovet po kompleksnoy probleme "Kibernetika". Voprosy bioniki (Problems of bionics) Moscow, Izd-vo "Nauka", 1967, 52-58

TOPIC TAGS: man, cerebrum, injury, visual perception

ABSTRACT: One thousand patients with focal injuries of the large hemispheres of the brain were studied to compare the effects of injuries of the dominant hemisphere (left) and subdominant hemisphere (right) on visual perception of an object. With massive injuries in the subdominant hemisphere including the temporal lobe, images are perceived as fragments. The patient does not see the object as a whole, but only separate details. The patient fills in the missing parts by guessing or by reasoning. This is also true of letters and numbers. Another perceptual characteristic of these patients is that often a picture shown for a brief period is not recognized by the patient when it is presented again. It is interesting to note that the patient can distinguish quite accurately, for example, between pictures of animals and inanimate

objects. The animal however, is not identified as a specific animal, but is recognized only as an animal in general. In the case of patients with injuries of the dominant hemisphere including the temporal lobe, more specifically its posterior sections, typical disorders of visual perception are of an opposite nature. The patients quite readily see the object as a whole, but occasionally have difficulty in separating the object from its background. These patients remember easily the objects presented and the order in which they are presented, but have difficulty in associating an object with a general category. For example, a cat is identified as a cat, but not as an animal. Thus, the "abstract attitude" is impaired and often names of objects are forgotten. It appears that the right temporal lobe participates in the process of seeing an object, letters or numbers as a whole and in the memorization and recognition processes. The left temporal lobe also participates in visual processing of objects, but not of letters or numbers. The left temporal lobe provides a higher form of processing including separation of an object from its background, more generalized perception, and the naming of a visually perceived object. Apparently to ensure the highest form of visual processing during evolution of the brain, it proved advantageous to separate some of the visual processing functions from the visual systems of the dominant hemisphere. Orig. art. has: 3 figures and 2 tables.

9.

AUTHOR: Kok, Ye. P.; Tsukerman, I. I.

ORG: none

TITLE: Specific and abstract perception of visual image recognition systems

SOURCE: AN SSSR. Nauchnyy sovet po kompleksnoy probleme "Kibernetika". Voprosy bioniki (Problems of bionics) Moscow, Izd-vo "Nauka", 1967, 40-43

TOPIC TAGS: visual perception, cerebrum, injury, form recognition

ABSTRACT: The concepts of the specific and abstract perception functions of man are respectively defined as the ability to recognize highly individual visual images, such as hand-writing, faces, or familiar objects, by their unidentifiable rationally specific traits, and the ability to recognize such group visual images as letters, regardless of their individual characteristics such as size, color, or form. It is pointed out, on the basis of clinical observations on patients, that the locations of these functions differ anatomically since the specific perception function is disturbed when symmetrical sections of the right hemisphere of the cerebrum are damaged, while the abstract perception function is disturbed when posterior sections of the left hemisphere of the cerebrum are damaged. It is indicated further that, depending on the degree and exact position of cerebral damage, the spectrum of perception disorders of either type may vary substantially, showing shifts of the recognition capability from group characteristics to specific individual characteristics and vice versa. Separate storage of specific and abstract information in the memory of computerized recognition systems is suggested. Orig. art. has: 2 figures.

10.

AUTHOR: Kurilova, L. M.

ORG: Laboratory of Physiology and Pathology of Sense Organsheaded by Prof. P. G. Snyakin/Institute of Normal and Pathological Physiology/directed by Prof. A. M. Chernukh/AMN SSSR, Moscow (Laboratoriya fiziologii i patologii organov chuvstv Instituta normal'noy i patologicheskoy fiziologii AMN SSSR)

TITLE: Gradual establishment of functional tone of skin temperature analyzer in man following exposures of skin and eyes to variable light intensities

SOURCE: Byulleten' eksperimental'noy biologii i meditsiny, v. 64, no. 12, 1967, 17-19

TOPIC TAGS: function analysis, dermooptic sense, light excitation, visual physiology

ABSTRACT: The existence of a functional link between visual and skin temperature analyzers was reported in a series of previous communications. This investigation was concerned with further studies of the effect exerted by light on the skin temperature analyzer, either directly or as mediated by the visual analyzer. Experimental data suggest that although skin receptors can be independently stimulated by light, this plays a subordinate role in visual light response mechanisms. In subjects exposed to sequential changes of light intensity, the functional tone of the skin temperature analyzer also changes. These changes coincide with the variations in intensity and duration of illumination. This paper was presented by Academician V. V. Parin. Orig. art. has: 2 figures.

11.

AUTHOR: Kuznetsova, I. N.

ORG: none

TITLE: Evaluation of image size in the human visual system

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 79

TOPIC TAGS: man, visual perception, form recognition

ABSTRACT: A tachystoscopic method with application of an erasing image was used to investigate the length of segments of straight lines and the size of drawings of objects and geometric forms. It was demonstrated that the evaluation time of image size does not depend on the information content of the stimulus, since it did not change when the number of evaluated dimensions of drawings increased from two to four and the number of lines of various lengths increased from two to eight, or with change in the correlation of probabilities of appearance of images of different dimensions in the series. Consequently, the size of images is evaluated by a set of specialized automatic mechanisms. The hypothesis (Glezer, 1966) on the existence in the visual system of independent channels for recognition of form and evaluation of size was verified.

12.

AUTHOR: Lashkevich, Yu. I.

ORG: none

TITLE: Some phenomena in the visual analyzer related to form recognition

SOURCE: AN SSSR. Nauchnyy sovet po kompleksnoy probleme "Kibernetika". Voprosy bioniki (Problems of bionics) Moscow, Izd-vo "Nauka", 1967, 48-52

TOPIC TAGS: form recognition, visual perception, human memory, audition

ABSTRACT: At the basis of any form recognition process there must be some specific interaction between a given sensory configuration and the memory traces. Similar interaction is possible between sensory configurations perceived simultaneously. When several identical figures are seen simultaneously, the similarity is noticed even if the figures are unfamiliar and there are no corresponding memory traces. Some of the different phenomena based on interaction of simultaneous similar perceptions include similarity or sameness, periodicity, regularity and bilateral symmetry. The same problem arises as in form recognition, namely, why do similar images produce the same effect regardless of their position on the retina and sometimes of their size and orientation. Possibly, the automatic comparison mechanism is based on the same principle as the comparison mechanism for a p. received

configuration with a memory trace. The author introduces the concepts of "recon" and "texton" in studying form recognition. "Recon" (derived from the Latin recon—thing) is used to designate individual units or objects (see Fig. 5), and "texton" (derived from the word texture) is used to designate a special surface or a one or two dimensional field (see Figs. 2 and 5). Texton recognition is important in everyday life as in the cases of differentiating clouds or landscapes, diagnosing skin disease and evaluating an ECG. An example of a one dimensional texton of zero complexity is a straight line, and an example of a one dimensional recon of zero complexity is a dot. The proposed division of images into two basic types is not limited to visual images. It is applicable to other modes of perception, particularly an auditory image. For instance, auditory textons can include the sound of a typewriter, human speech in a specific language and music of a given form. Examples of auditory recons can include a shot, a separate word and a musical phrase. As observed in Fig. 5, both recons and textons can be divided into smaller units. With recognition mechanisms closely related to one another, it is difficult to understand the recognition mechanisms of ordinary images without a further study of textons. Orig. art. has: 5 figures.

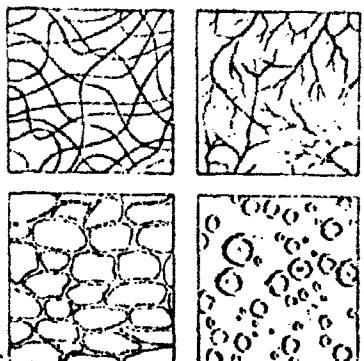


Fig. 1. Examples of two dimensional textons.

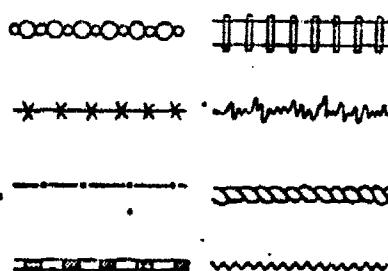


Fig. 2. Examples of linear or one dimensional textons.

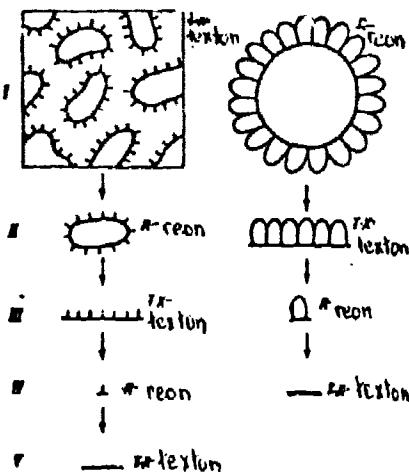


Fig. 5. Examples of hierarchical structure of images.

13.

AUTHOR: Lauringson, A. I.

ORG: none

TITLE: Experiments in eye movement regulation

SOURCE: AN SSSR. Nauchnyy sovet po kompleksnoy probleme "Kibernetika". Voprosy bioniki (Problems of bionics) Moscow, Izd-vo "Nauka", 1967, 382-387

TOPIC TAGS: bionics, cybernetics, approximation

ABSTRACT: Eye-movement regulation when the eyes follow a moving target is studied experimentally. Four subjects with normal vision were tested for horizontal motion by a photooptic method. It is found that when the camera slit moves with a duration of less than 0.1 sec, the eye cannot predict its motion. The eye-movement system can with sufficient accuracy approximate and predict linear, parabolic, or exponential motion. Regular slit movements can be predicted with a certain accuracy with one-time input of information into the system. With nonregular motion, corrections must be made in the initial approximation. Orig. art. has: 7 formulas and 10 figures.

14.

AUTHOR: Lovitskiy, V. D.

ORG: none

TITLE: Energy transformations of information in the activity of the human cutaneous temperature analyzer

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 84-85

TOPIC TAGS: man, peripheral nervous system, temperature conversion, skin physiology, temperature instrument, signal processing

ABSTRACT: The receptor act is a complex process of transmission of information from its source to the cortical section of the analyzer, which accomplishes fine analysis and synthesis of the message received. The receptor communication channel consists of nonuniform sections with boundaries where both the physical carrier and the code of the perceived signal are transformed. One of the least studied processes is that of signal recoding on the skin-thermoreceptor boundary. For study of energy transformations of information on the skin-thermoreceptor boundary, experiments were performed on a specially constructed temperature adequatometer which had broad capabilities for thermal stimulation of impulses. The device applies single, pair, and series thermal stimuli of given intensity and duration. The data obtained led to conclusions on temperature changes on the surface of the irradiated section of the skin and in the depth of the thermoreceptors and to hypotheses on the existence of start-up mechanisms for the activity of the human temperature analyzer.

15.

AUTHOR: Makarov, P. O.; Korzun, P. A.; Shostak, V. I.

ORG: none

TITLE: Reaction of the visual system to a momentary powerful light stimulus

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 87-88

TOPIC TAGS: visual perception, psychometry, cerebral cortex

ABSTRACT: The effect of momentary (1 msec) and intense ( $10^6$  international candles) exposures of the eye on the electric and light sensitivity of the visual analyzer was studied. Electric sensitivity was investigated in different intervals of time — within 3-130 msec, 0.5-10 sec, and 0.5-60 min after exposure. In the first interval it was determined with an optical adequatometer and in the other two with equipment for electric stimulation. Light sensitivity was determined with an optical adequatometer and an ADM adaptometer. It was established that the curve for change in electric sensitivity is analogous to the curve characterizing the reaction to a single stimulus of an underdamped system, i. e. of a second order system. The curve for change in light sensitivity corresponds to the curve characterizing the reaction to a single stimulus of a system with critical damping or even overdamping, i. e. of a first order system. It can be supposed that the functional mobilities of the links of a visual system which determine the light and electric sensitivity of the eye are dissimilar.

10.

AUTHORS: Markitanova, S. A.; Rudometova, S. B.; Chudinovich, B. M.

ORG: none

TITLE: Experiments on training a man to recognize visual images

SOURCE: AN SSSR. Nauchnyy sovet po kompleksnoy probleme "Kibernetika". Voprosy bioniki (Problems of bionics) Moscow, Izd-vo "Nauka", 1967, 101-107

TOPIC TAGS: training procedure, visual signal, pattern recognition, recognition process, selection rule, algorithm

ABSTRACT: Experiments were conducted to determine the reliability with which man recognizes visual images. The length of the training, the nature of the pattern, and the distinguishing criteria were varied. The results were used to evaluate machine algorithms and to determine which distinguishing functions man uses and how he does it. The pattern was a  $2 \times 2$  (or  $3 \times 3$ ) panel of 4 (or 9) squares which were either white or black. After looking at the training sequence, the subject viewed a test sequence and indicated which patterns satisfied the distinguishing criterion. The reliability ( $R$ ) with which he recognized the pattern was calculated. Among the criteria were: the whiteness or blackness of a particular square; a certain configuration of the darkened squares; a minimum number of black squares, or a logic dichotomy. With simple criteria,  $R$  increased with short training periods. The logic criteria proved too complex for use. In certain cases, transformation of the test object was required. Among the machine algorithms, the Bongard and potential functions of  $1/(1 + r)$  proved totally useless, and the Braverman function proved useful only in the simplest cases. Comparison of  $R$  for high school students and college undergraduates showed that the students'  $R$  improved most rapidly with short training, probably because the set of distinguishing criteria available to them was more limited. Orig. art. has: 11 figures.

17.

AUTHOR: Melikadze, N. L.

ORG: none

TITLE: Transforming functions of receptor areas and the subject's maximal identification capabilities

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 93-94

TOPIC TAGS: man, form recognition, psychometry, cerebral cortex

ABSTRACT: The transforming functions of receptor areas were defined and their properties investigated. Psychological experiments were conducted for quantitative study of the properties of those transformations of parallel flows of information which occur in the "eye-brain" system. Human maximal identification capabilities were evaluated during recognition of flat discrete forms.

18.

AUTHOR: Nevskaia, A. A.

ORG: none

TITLE: Invariance of visual recognition in man and its limits

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 101-102

TOPIC TAGS: visual perception, man, form recognition

ABSTRACT: Time characteristics were determined for form recognition which are intelligibly combined into one class but can not be obtained one from another by any optical transformations (various forms of like items or objects capable of changing their form). It was demonstrated that by introducing several variations of such images into the alphabet of presented forms, the time necessary for visual recognition increases the same as with introduction of completely different unlike forms. Consequently, forms combined only by an intelligible similarity do not make a single visual image. Prolonged training of the observer in the identification of such form variations failed to develop characteristics in the visual system which separate the forms into classes exactly corresponding to the concepts.

19.

AUTHOR: Novotnyy, Z. (Czechoslovak SSR)

CFG: none

TITLE: Method for experimental study of reflex interaction of analyzer systems

SOURCE: Kosmicheskaya biologiya i meditsina, v. 1, no. 4, 1967, 36-40

TOPIC TAGS: reflex activity, simulation test facility, spatial perception, man, vestibular analyzer

ABSTRACT: Techniques and equipment recommended for studying the effect of different analyzer systems on changes in human posture and spatial position are described. The equipment—an unstable platform (see Fig. 2)—is based partially on a rocking chair designed by Soviet specialists and partially on the device used by Chodöra to investigate the conditioned falling reflex. The platform consists of a stationary lower plank 5 for supporting the somewhat smaller and "rocking" upper plank 6. Rubber rollers (1), 4.5 cm in diameter, are mounted on the lower plank. Above them the upper plank is provided with bushings (2) in which short perpendicular pegs (3) are mounted. Peg (4) with a rounded end is mounted in the middle of the lower plank; it fits into a brass cup (5) mounted to the bottom of the upper plank to form a swivel for the latter. Rotatable metal supports (7) are at the corners of the lower plank. They can be positioned to support the upper plank in case of extreme stress. Recording equipment is attached to the lower plank. Movement of the upper plank results in pressure changes on small plastic cylinder (11), and in change in resistivity in the two conducting rubber strips (8) attached to a Wheatstone bridge (9) and to 4.5-v battery (10). The fluctuations in current produced are amplified and recorded. In some modes the equipment can simulate horizontal plane flight. The interaction between the vestibular apparatus (galvanically stimulated) and motor reflex activity was examined. Further studies will be made using different combinations of specific impulses for other analyzers. Despite the shortcomings of the conducting rubber bands (due to changes in mechanical and electrical characteristics) for recording movements of the platform, the use of this equipment is recommended for studying dynamic changes in muscle stress, for conditioning the vestibular apparatus, and for studying vestibular stimulation of the extracorticospinal system. Orig. art. has: 3 figures.

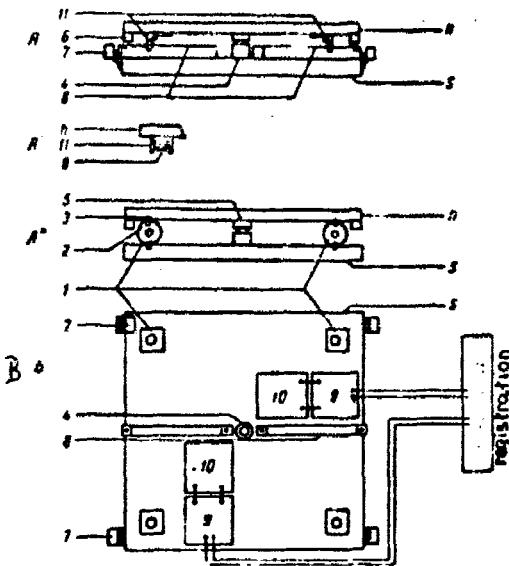


Fig. 2. Diagram of unstable platform.  
 A—front view of platform,  
 A'—reinforcement of rubber roller to top  
 plank (side view),  
 A''—side view of platform,  
 B—bottom of platform (top view).

20.

AUTHOR: Turkina, N. V.

ORG: none

TITLE: Identification of symbol indication in the human visual system

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 151

TOPIC TAGS: visual perception, man, information processing, form recognition

ABSTRACT: Investigation of the identification of the location of points, letters, and geometric figures and symbols in the field of vision indicated: 1) identification time for location of a point in the field of vision does not depend on the quantity of information given, since the visual system processes as much information as it receives in a given time period; 2) the identification time of a limited set of letters also does not depend on information quantity; and, 3) the identification time of geometric figures and symbols with only a small number of symbols in the set does not depend on the information content of the stimulus. It can be supposed that specialized automatic mechanisms exist in the visual system for identification of a limited set of letters and the location of points.

**NOT REPRODUCIBLE**

21.

AUTHOR: V. Ronin, L. G.; Konovalov, V. F.

SOURCE: Department of the Physiology of Higher Nervous Activity, MGU (Kafedra fizio-  
logii vysshey nervnoy deyatel'nosti MGU); Institute of Higher Nervous Activity and  
Electrophysiology, AN SSSR, Moscow (Institut vysshey nervnoy deyatel'nosti i  
neurofiziologii AN SSSR)

TITLE: Electrographic data on the work of "biological clocks" in the human brain

SOURCE: Voprosy psichologii, no. 6, 1966, 87-94

TOPIC TAGS: neurophysiology, biologic clock, circadian rhythm, central nervous system, electrophysiology

ABSTRACT: Subjects were examined polygraphically in a darkened, soundproof room. EEG's, skin galvanic, and oculomotor reactions were recorded using an eight-channel Avsat EEG. A combination of a conditioned audiostimulus and light stimulus (re-inforcement) was used. The 500-cps audio stimulus was 40—50 db above threshold. The duration of both stimuli was three sec, with a 60 sec interval between stimuli. This arrangement facilitated a study of the trace reaction and its time factor. In discussing the results of this study, it was stated that the data did not provide evidence of a biological clock phenomenon in any one structure of the brain. The dynamics of electrographic reactions during the formation of a link between coupling stimuli was described and the possible time mechanisms of the human brain were discussed. Orig. art. has: 3 figures.

[CD]

22.

AUTHOR: Voytinskiy, Ye. Ya.

ORG: none

TITLE: Analysis of information in sensory systems and measurement of the EEG signal-noise ratio

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 24

TOPIC TAGS: man, central nervous system, peripheral nervous system, EEG, signal noise separation, vision, audition

ABSTRACT: During investigations of electric responses of the brain to afferent stimulation, useful signals are separated from noise by methods of filtration, storage, and correlation. However, it is not enough just to separate the signal from the noise. To evaluate the work of sensory systems under different physiological and pathological conditions, it is also necessary to measure the signal-noise ratio. This report describes an apparatus for measuring the EEG signal-noise ratio and some results obtained. The experimental equipment included an electroencephalograph, a photophone stimulator, an apparatus for measuring the signal-noise ratio, and an automatic

ecording potentiometer. The research was conducted with healthy test subjects using rhythmic light and sound stimuli. Data were obtained on the dynamics of the signal-noise ratio with change of three parameters of stimulation: frequency, intensity, and the impulse time lag. Parameters were established for light and sound stimuli, giving maximal and minimal values for the signal-noise ratio. Information was obtained on the effects of masking and sensitization during simultaneous and sequential action of stimuli with different modalities. Under optimal conditions of adjustment of the visual and auditory systems, the signal-noise ratio reaches 8:10 and 6:7, respectively.

23.

AUTHOR: Zav'yalov, A. V.; Komissarov, V. I.

ORG: none

TITLE: Coadjustability of the sensitivities of the human kinesthetic, visual and auditory systems

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 46-48

TOPIC TAGS: man, vision, audition, peripheral nervous system, central nervous system, muscle stimulation, correlation function, reflex activity

ABSTRACT: Presence of tonic and diffuse thalamocortical ascending influences presumes the existence of a specific coadjustability in the activity of different sensory systems. Functional activity of basic human analyzers was compared to detect this coadjustability. The total quantity of minimal increments of perception over a wide range of strength increase of an adequate stimulus was used as an index of sensory system activity. Values of differential thresholds with different intensities of initial stimulation were also taken into account. The investigation was conducted with a special kinesthesiaimeter, an adaptometer, and an AU-4 audiometer. In order to find the presence, form, and value of a connection between the activity indices of the sensory systems, the data were processed by a statistical method of correlation. Two hundred and ninety-eight experiments were conducted on 149 subjects 18 to 25 years old. It was found that the total quantity of minimal increments of kinesthetic perception correlated well with the same indices for visual and auditory perception. The correlation coefficients ( $r$ ) between the compared values respectively equalled: + 0.675 ( $P < 0.01$ ) and + 0.614 ( $P < 0.01$ ). A connection ( $r = + 0.709$ ) was found between the functional activity of the kinesthetic analyzer and the capacity of the auditory organ to distinguish sounds with a different pitch. Hence it follows that high sensitivity of one sensory system is accompanied by high sensitivity of another, and hyposensitivity of one analyzer is accompanied by reduced sensitivity of another. This proves the existence of a system which establishes a definite coadjustability of specific activity of different afferent systems. However, comparison of absolute thresholds of sensitivity or of thresholds with weak initial stimulation of different analyzers did not reveal any correlation between the compared indices. The thresholds under initial stimulation of average intensity displayed a direct correlation. However, the highest value of union between different thresholds was attained with relatively weak initial stimulation. When the sensitivity of one

analyzer was determined on a background of adequate stimulation of another, the correlation between their activity levels either sharply declined or disappeared. Consequently, when the reflex interaction of sensory systems is strengthened, their initial coadjustability levels off. It can be considered that unidirectional influences, directed to different afferent systems, dominate under conditions of relative rest. This also leads to parallelism in the oscillations of sensitivity of sensory apparatuses. Adequate stimulation of one apparatus causes phase and multidirectional influences which change the stable level of sensitivity of the analyzers. Coadjustability of sensitivity of the sensory systems can be an important mechanism for coordinating their activity. It apparently promotes coordination of the effectiveness of assimilation of information arriving at the inputs of different sensory systems.

## Sub-Section 2. Infra-Human Sensory Processes

24.

AUTHOR: Arshavskiy, Yu. I.; Berkinblit, M. V.; Gel'fand, I. M.; Keder-Stepanova, I. A.; Smelyanskaya, E. M.; Khlopov, A. V.; Yakobson, V. S.

ORG: none

TITLE: Background activity of Purkinje's cells of the cerebellum

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 8

TOPIC TAGS: cat, cerebellum, cell physiology, neuron, biopotential

ABSTRACT: The activity of Purkinje's cells in the anterior and paramedian lobes and in an isolated stria of the cerebellar cortex of a cat was recorded. The action potentials were recorded on magnetic tape, which was then processed on a digital computer. Histograms on the distribution of interimpulse intervals and a postimpulse probability curve were constructed. The nature of the relationship between successive intervals was determined. Purkinje's cells are characterized by a high level of background activity with an average frequency of 30-50/sec. The histograms for interimpulse intervals of different cells are similar to each other, being asymmetrical curves with one maximum in the range of 10-20 msec. A correlation is found between the durations of successive intervals. The background activity of a Purkinje cell does not change in the course of two to three hours of recording of the neuron. The activity of Purkinje's cells in the anterior and paramedian lobes has similar characteristics. The average frequency of background activity of Purkinje's cells practically does not change in the isolated stria of the cortex of the anterior lobe. However, the histogram of interimpulse intervals becomes more symmetrical, mainly due to a reduced percentage of the longest intervals. The nature of the background activity of Purkinje's cells will be considered on the basis of the results obtained.

25.

AUTHOR: Bertulis, A.; Glezer, V. D.; Kostelyanots, N. B.; Podvigin, N. F.; Shetalov, I. N.

ORG: none

TITLE: New data on the functional organization of a receptive CN-field of a retina and its model

SOURCE: AN SSSR. Nauchnyy sovet po kompleksnoy probleme "Kibernetika". Voprosy bioniki (Problems of bionics) Moscow, Izd-vo "Nauka", 1967, 37-39

TOPIC TAGS: frog, visual physiology, biologic model, electrorotinography, light excitation

ABSTRACT: Receptive CN-fields of an isolated frog retina were studied by electrorotinogram methods to determine the dependence of impulse responses of a ganglionic CN-cell on the area and intensity of a light stimulus. It was found that with low light intensities, the number of impulses in the response grows with increase of stimulus area. With medium light intensities, the response first increases with increase of stimulus area; but, further increase of the area leads to a decreased response. With high light intensities and increased stimulus area, the response decreases immediately. The same type of dependence was found in similar experiments on human subjects. Thus, the functional organization of the field is determined by the level of the acting signal. With low signal levels the retina works as a self-adjusting spatial filter of low frequencies, and with high signal levels the retina works as a self-adjusting filter of high frequencies. Inhibition appears not only with stimulation of the peripheral field receptors, but also appears over the entire field and is only more markedly expressed at the periphery. This is confirmed by experiments in which a band of light was passed across a receptive field at different speeds. The results were paradoxical. The higher the speed, the smaller the number of impulses in the response and the longer the latent period. If the response is determined by simple summation, then the results should be just the opposite. This fact and literature data indicate that the rates of growth (time constants) of the excitation and inhibition processes are different. A hypothesis on the functional organization of a receptive field is proposed based on the interrelations of the excitation and inhibition processes in time and space. The hypothesis states that the functional organization of a retina receptive field is determined only by the light intensity falling on a given section of the retina, is not performed ahead of time, but is formed in the course of light stimulus action. Limited summation zones are related to the appearance of an inhibiting process which is more markedly expressed at the field periphery. The signal is transmitted from the field by the number of impulses in the CN-response. It was also found in the electrotinogram that the amplitudes of the negative beta-wave and positive alpha-wave both display the same dependence on area and intensity of the light stimulus. On the basis of study data an electronic model of a retina was constructed consisting of passive elements which include photodiodes, semiconductor diodes, resistors and condensers. The following operations can be performed by the retina model: adaptation, time and spatial changes with light intensity change, delta-modulation, and discrimination of image contours. At low light intensities, the retina model operates as a spatial filter of low frequencies, and at high frequencies it operates as a spatial filter of high frequencies.

26.

AUTHOR: Bogdanov, O. V.

ORG: none

TITLE: Development of feedback and a cyclic rhythm of excitation in chicken embryogenesis

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 13-14

TOPIC TAGS: embryology, brain, neuron, chicken, electrophysiology

ABSTRACT: Comparison of the development of electric activity in the brain of the chicken embryo with the development of movements indicates that the penetration of afferent information from the kinesthetic apparatus about a completed movement appears at a definite period of embryogenesis, when the central structures themselves still do not actively influence performance of a motor act. This period should be considered the formation phase of a feedback mechanism for signalling completed movements. A second phase, that of control and correction (according to Bernshteyn) or of sanctioning (according to Anokhin), appears later when the neurons of the central nervous formations are formed cytologically and intranuclear and internuclear connections of the central nervous system are established. Ballok (1957), Polyakov (1954), Grashchenkov and Latash (1954), Bernshteyn (1966), and Eccles (1956) established the loop structure of central nervous system functioning as a continuous cyclical process. The present experiments, with anemization of the embryo head and sudden afferent transmission into the central neural formations, show that there are separate sections of the brain which have a longlasting automatism indicated by indices of electric activity. It must be assumed in this case that strong afferent stimulation leads to excitation of separate neuron groups resistant to anoxia, and takes place in a closed loop within the given structure.

27.

AUTHOR: Chichvarina, N. A.; Dudkina, N. A.; Yaremenko, N. G.

ORG: none

TITLE: Algorithms for decision making in a problem situation

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 161

TOPIC TAGS: rat, algorithm, conditioned reflex

ABSTRACT: Limitations applied to an information situation have great significance for the development of behavior algorithms. These limitations can be represented in the form of a list and presented in a table, where each information situation has a corresponding set of limitations and an algorithm which solves problems in this situation. The purpose of the investigation was to develop algorithms in rats for decision making in an information situation. The initial situation was represented in the form of a word in a given alphabet composed of signals such as light or whistling. A word in the alphabet was represented by a complex stimulus of three letters (signals). A system of substitutions existed which enabled passing from one word to another. The substitutions were preliminarily developed in the form of chain conditioned reflexes of three links. Each element of the complex stimulus was preliminarily extinguished. The problem consisted of the recombination of substitutions during transition from one word (the complex stimulus), which had not been presented previously, into another word for which a reflex had already been developed. Each original link of the substitutions appeared as letters for the initial situation (word).

28.

AUTHOR: Chichvarina, N. A.; Malozemova, V. N.

ORG: none

TITLE: Algorithms for rat behavior in probability conditions of reinforcement

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 161-162

TOPIC TAGS: rat, behavior pattern, algorithm, probability, conditioned reflex, learning process

ABSTRACT: Different stages in the formation of intermediate systems of reflexes based on probability reinforcement are very important in investigating the process of decision making in dynamic information situations. Certain algorithms were developed for decision making, learning, and self learning, in relation to probability reinforcement of different types at various stages of development of complex systems of conditioned reflexes in rats. It was found that the addition of a new link in a chain of conditioned reflexes in an environment during reinforcement with probability equal to two-thirds leads to step changes in behavior. First there is a system of actions which makes it possible to solve the problem without errors, and then a

period sets in characterized by a large percent of errors. During reinforcement with probability equal to th co-quarters there is cyclic testing of reinforcement carried out both in the presence of a signal and without it.

49.

AUTHOR: Dolyatovskiy, V. A.

ORG: none

TITLE: Dynamic processes in the curved cochlea of an auditory organ

SOURCES: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neurokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 37-38

TOPIC TAGS: audition, neuron, mathematic model

ABSTRACT: The projection on a vertical plane of a cochlea membrane of an auditory receptor is described by equations for a hyperbolic spiral  $\rho = \alpha/\varphi + \rho_0$ , where  $\rho_0 < \rho < \rho_{\max}$ . Equations for three-dimensional spirals are described by spherical coordinates  $\rho = \rho(\varphi, \theta)$ . A differential equation in partial derivatives is examined which describes the process of movement of the perilymph in the canals of a curved cochlea. Solution of this equation is proposed in the form of pressure distributions. The deformations of the tectorial and basilar membranes were found. As a result of differences in the mechanical properties and structure of the membranes, the difference in distances between them is  $\Delta z(x,y) = F(I, \omega, x, y)$ , where I and  $\omega$ , the intensity and frequency of the acting stimulus, have varying values. Due to this, the zone of deformation of the stereocilia decreases. The sharpening of selectivity and the narrowing of the receptive zone of the first neuron can be connected with the mechanics of the membranes of the cochlear passage. The form of the cochlea with increasing curvature along its length can be connected with normalization of the amplitude of deformation of the stereocilia under action of signals of a different frequency and with compensation of the weight of the membranes under perception of small signal amplitudes. Excitation of the stereocilia of the hair cells in movement was examined. The deflection angle of stereocilia is maximal in a small zone of deformations of the basilar membrane and has a different value for receptor cells of different rows. Calculation of the excitation of hair cells under action of signals of different intensity demonstrates that the excitation zone of stereocilia expands with increase of I. Models of a possible transformation on the level of receptor cells were examined. The deflection of stereocilia  $\varphi$  leads to change in the internal potential and in cell  $u' = k\psi - du$ . The internal potential of the hair cells is transformed to the rhythmicity of the spiral ganglion neurons. Consequently mathematical models of such a transformation are proposed. The variable value for the neuron threshold, determined by its energy balance, leads to spontaneous activity (floating zero). At the same time the rhythmic neuron discharges induced by the stimulus are coordinated with the dynamics of the cochlear processes. Simplified models of dynamic processes in a cross-section of the cochlea are examined. Transitional processes for sections of the basilar and tectorial membranes were calculated and the function  $\Delta z = F(x, t)$ , describing change in the distance between membranes, was determined. It was established that certain psychophysical characteristics of hearing can be explained by transitional processes in the receptor.

AUTHOR: Fokin, V. P.

ORG: none

TITLE: Dynamics of change in the b-wave under the effect of rhythmic light stimulation in the center and on the periphery of the cat retina

SOURCE: Vsesoyuznaya konferentsiya po neirokibernetike, 3d, Rostov-on-Don, 1967. Problemy neirokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 156

TOPIC TAGS: cat, visual perception, electrorretinography

ABSTRACT: The b-wave of the electrorretinogram was chosen as an index of the functional state of the retina, as reflecting the work of the bipolars. B-waves were recorded from internal nuclear layers of the retina with the position coordinates of the microelectrode determined by an ophthalmoscope. The experiments were performed on cats anesthetized with sodium amyta, using a bright flashing light as the stimulus. The experiments were conducted during adaptation to darkness and during different levels of light adaptation. The amplitude of the b-wave during a single light stimulation was accepted as 100%, and the dynamics of change in the b-wave were studied in relation to the frequency of the flashing light. Prolonged rhythmic stimulation of the retina was accompanied by change in its constant potential synchronized with change in b-wave amplitude. Polarization of the retina with a constant current led to change in b-wave amplitude for a single stimulation similar to the effect of rhythmic light stimulation. The similarity is complete, but only for the state of adaptation to darkness. During light adaptation the effect of the constant current is more complex. Thus the data obtained indicate the presence of multichanneling on the level of the retina in the organization of the visual analyzer.

31.

AUTHORS: Gor'yan, I. S.; Meyerson, Ya. A.; Tonkonogiy, I. M.; Frantsevich, L. I.; Tsukerman, I. I.

ORG: none

TITLE: Statistical characteristics of images as indications of forms

SOURCE: AN SSSR. Nauchnyy sovet po kompleksnoy probleme "Kibernetika". Voprosy bioniki (Problems of bionics) Moscow, Izd-vo "Nauka", 1967, 118-124

TOPIC TAGS: statistics, statistic analysis, computer, computer application

ABSTRACT: Research by various scientists in the field of distinguishing textures by statistical analysis is reviewed. Bees' ability to distinguish textures synthesized into statistical patterns by computers was studied by Yu. S. Nedochetova, N. P. Soloshchenko, L. I. Frantsevich, and I. I. Shalimov (1967. Krazlicheniyu nasekomymi raschlenennosti konturov figur. Nast. sb.). The necessity for several parameters (rather than a single one) to make a meaningful texture classification is mentioned, as are the methods of calculating surfaces by L. A. Ayzerman, E. M. Braverman, and L. I. Rozonoer (1964. Teoreticheskiye osnovy metoda potentsial'nykh funktsiy v zadache ob obuchenii avtomatov razdeleniyu vkhodnykh situatsiy na klassy. - Avtomatika i telemekhanika, 25, No. 6) and G. Sebastian (1965. Protsessy priyatiya resheniy pri raspoznavanii obrazov. Kiev). The work of D. S. Lebedev and

I. I. Tsukkerman (1965. Televideniye teoriya informatsii. M. - L.) on the statistics of building a visual system is discussed briefly. The use of n-grams and difficulties presented with the increase of n are noted. The results of experiments on the physiology of animal vision by D. H. Hubel and T. N. Wiesel (1959. Receptive fields of single neurones in the cat's striate cortex. - J. Physiol., 148) are mentioned. The work of I. S. Gorlyan and I. I. Tsukkerman (1966. Raspoznavaniye izobrazheniy po ikh statisticheskim svoystvam. - Teoriya Kino i televideniya, No. 2) using computers and television equipment to classify soil images is discussed. The results of psycho-physiological experiments (using tachistolic measurements), on distinguishing textures according to thresholds of differentiation artificially established by computer are presented. Orig. art. has: 6 figures.

32.

AUTHOR: Grinyavichus, K.; Gutman, A.; Milyukas, V.; Milyauskas, R.

ORG: none

TITLE: Two states of the rabbit visual cortex — two subprocesses in the electrocorticogram

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 35-36

TOPIC TAGS: rabbit, cerebral cortex, electrocorticogram, neuron, visual perception, anesthesia, biopotential

ABSTRACT: It was previously demonstrated (Grinyavichus, Gutman, 1966) by analysis of one-dimensional distribution that electrocorticogram potentials recorded with a time constant of approximately two seconds assume two predominant values, differing by 0.5 mv. Next (Grinyavichus, Gutman, 1967) it was ascertained that the more extreme values of the high frequency part of the electrocorticogram match the more positive of these two values. Consequently the electrocorticogram is examined as a set of two subprocesses, intermittent in time, with various mean values of potentials and with high frequency components. During a pharmacological experiment, if the following occur: a) the number of extremes increases together with the degree of cortex excitation (Mitskis, 1966); b) the number of neuron spikes of the visual cortex also increases to the same degree as the number of extremes (Milyukas, 1966); c) spike activity is higher with positive values of the potential; and, d) during deep anesthesia a negative subprocess predominates which upon waking is increasingly superseded by a positive one; then, it can be considered that a more awakened state of the cortex corresponds to a "plus" subprocess (a greater frequency of neuron responses) and a more inhibited state corresponds to a "minus" subprocess. The general state of the cortex is determined to some extent by the probabilities of transitions from "plus" to "minus" and vice versa.

33.

AUTHOR: Ibragimbekova, Sh. S.; Semenova, B. V.; Krauze, N. V.

ORG: none

TITLE: Investigation of algorithms for the formation of systems of defense reflexes in rabbits

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-On-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 51-52

TOPIC TAGS: rabbit, algorithm, reflex activity, blood pressure

ABSTRACT: In this study, rules for the development of defense reflex systems were worked out which indicate substantial differences in the algorithms of different systems. In experiments on rabbits it was attempted to induce development of a hypertensive state analogous to a state that had been obtained in dogs. A system of defense reflexes was developed and strong stimuli were applied; then, strong stimuli were excluded from the experiments and conditioned stimuli were repeatedly applied. Under these conditions, clearly expressed hypertension and switching from a certain system of reflexes to a pathological system of reflexes could not be induced. Instead, these conditions usually led to the appearance of a clearly expressed neurotic condition in the dogs and to the development of pathological systems of conditioned reflexes in the rabbits. These facts indicate that in rabbits there is a substantial difference in the organization of algorithms for the formation of reflex defense systems both in the normal state and under conditions connected with the appearance of negative emotions. It was also found that the described sequence of applied stimuli acting on higher nervous activity in rabbits does not lead to high level changes of brain work algorithms, and thus pathological programs for the regulation of blood pressure levels do not appear. The facts indicated are also examined from the viewpoint of features of information processing in the brains of rodents.

34.

AUTHOR: Karandeyev, K. B.; Puchkin, B. I.; Subbotin, M. Ya.;  
Finkinshteyn, Ya. D.

ORG: none

TITLE: Certain general principles of chemoreception as illustrated by the odor perception mechanism

SOURCE: AN SSSR. Nauchnyy sovet po kompleksnoy probleme "Kibernetika". Voprosy bioniki (Problems of bionics) Moscow, Izd-vo "Nauka", 1967, 27-30

TOPIC TAGS: olfaction, animal physiology, esterase, acetylcholine, cholinesterase

ABSTRACT: In view of the various theories proposed to explain the olfactory receptor process, the authors attempted to determine whether it is a chemoreceptor process. Morphophysiological studies were conducted on fish and frogs to determine olfactory receptor function. The electric activity of the mitral cells of the olfactory bulbs in frogs and biocurrents in the olfactory nerves in fish were measured, and histochemical methods were used in determining esterase and cholinesterase activity of the mucosa. Introduction of acetylcholine to the olfactory mucosa increased the bioelectric activity of the olfactory bulbs and nerves, just as the action of an odoriferous material did. The same enzyme activity distribution was also effected--the specific cholinesterase in the hairs and adjacent cells, and the nonspecific esterase in the olfactory epithelia and especially in the apical parts of the sustentacular cells were activated. Application of eserine inactivated cholinesterase and reduced esterase activity. Thus the acetylcholine-cholinesterase mechanism is involved in the smell-perception mechanism. Olfactory reception is exterochemoreception. Specialization (development of a covering layer which comes in direct contact with the odor-producing material) has changed the structure of the receptors but they function in generally the same manner as chemoreceptors. The stimulus (the contact between the structure and the odoriferous material) determines the amount of mediator (acetylcholine) given off, which in turn controls the generation of a potential and discrete impulse of a given frequency, forwarding the information to the central nervous system. The authors conclude the observed principles of chemoreceptor functioning can be used in modeling and construction of appropriate data units.

35.

AUTHOR: Kostelyancts, N. B.

ORG: none

TITLE: The inhibiting interaction of sections inside the retinal receptive field as a mechanism of trace masking

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1957. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 71-72

TOPIC TAGS: frog, visual perception

ABSTRACT: Receptive "off" fields of the frog retina were investigated by projecting two black stimuli on adjacent sections in the center of the retina receptive field and varying the interimpulse interval from 0-240 msec. Simultaneous presentation of both stimuli at first gave a response lower than the combined responses resulting from separate presentations. When the interval was increased to 10-20 msec, the reverse occurred. Further increase of the interval increased the total of separate presentations. The decrease at 10-20 msec in the response to separate presentations and its subsequent increase with prolongation of the interimpulse interval reflect the development in time of an inhibiting influence which sections of the field, excited by the simultaneous presentation, adjacent sections. This influence appears immediately upon the first simultaneous presentation, attains a maximum at 10-20 msec, and lasts for more than 200 msec. The presence of such amplitude-time characteristics of the effect of a masking stimulus on the perception of a subsequent stimulus by the human visual system is well known. It appears that the trace masking effect is caused by the inhibiting influence which one excited section exerts on adjacent sections in the center of the receptive field.

36.

AUTHOR: Krol', V. M.; Skripnikov, A. G.

ORG: none

TITLE: Binocular interaction on the levels of the lateral geniculate body and of the cortex of the visual analyzer of the cat

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 75-76

TOPIC TAGS: cat, visual signal, biopotential

ABSTRACT: Morphological and physiological data on the multi-channel conductivity primary afferent information in the visual analyzer (Lyubimov, 1964) indicate convergence of the two channels connecting both eyes at the level of the lateral geniculate body and both lateral geniculate bodies at the level of the cortex. The hypothesis on the binocular summation of visual signals, which is linked with increase in the resolving capacity and reliability of the visual analyzer, was tested. The relationships plotted for each eye of amplitude of the induced potential to the brightness and duration of the stimulus have a relay character. In accordance with the hypothesis, the amplitude of the induced potential was calculated under conditions

of binocular interaction and tested in the experiment. The characteristics were read under conditions of diffuse ( $10^{\circ}$  to  $20^{\circ}$ ) and local ( $1^{\circ}$  and less) photostimulation, and also under conditions of electric stimulation of an unanesthetized cat. [Abstracter's note: The original does not indicate whether the hypothesis was verified or not.]

37.

AUTHOR: Kuchina, Ye. V.

ORG: none

TITLE: Experimental study of form recognition principles

SOURCE: AN SSSR. Nauchnyy sovet po kompleksnoy probleme "Kibernetika". Voprosy bioniki (Problems of bionics) Moscow, Izd-vo "Nauka", 1967, 43-47

TOPIC TAGS: monkey, form recognition, visual perception, learning process

ABSTRACT: Experiments were staged on a 5 yr old female green marmoset monkey and a 7 yr old male baboon to study the searching processes involved in solving form recognition problems. Essentially, the question was whether any special characteristics of the form were used in the recognition process. The animals were shown a group of eight pictures depicting circles with a loop attached at different points of the figure; a ninth circle had no loop. A device representing a box divided into 8 sections with movable doors was used to display the pictures at random. Only two sections of the box were used. First, a positive conditioned reflex was developed to a circle with a loop at the upper part of the figures. When the animal learned to open the correct door, the reflex was reinforced with food. Then the animal had to differentiate between a circle with a loop and a circle without a loop. In later experiments the position of the loop on the figure was changed, but the animals had little difficulty in solving the problems. The solving process can be divided into three stages. In the first stage the animal adjusts to experimental conditions and responds to the sound of the door opening rather than the picture. The animals opened the correct door with the same frequency as they opened the wrong door. In the second stage the animal begins to differentiate between the stimuli. As the animal approaches the pictures, it looks at both pictures for a long time and then opens the correct door. The third stage is divided into several substages and involves problem solving under more difficult conditions. The animal has to separate the essential characteristic and abstract it from an increasing number of inessential characteristics. During this period, as in the first period, the animal runs to the box at the sound of the door opening without looking at the pictures. But, now knowing the algorithm of solving the problem the animal upon approaching the box immediately makes the correct choice. In the second, third and fourth experimental series other geometric figures with and without loops were used successfully. The animals recognized the new forms on the basis of the essential characteristic--the presence or absence of the loop. Only the qualitative aspects of the results were considered in this study. Probably a mathematical analysis of the experimental data would clarify some of the quantitative regularities which lie at the basis of the form recognition process. Orig. art. has: 5 figures.

38.

AUTHOR: Kvastel', L.; Malinin, L. K.; Protasov, V. R.

ORG: none

TITLE: Determination of fish sensitivity to some chemical substances

SOURCE: AN SSSR. Nauchnyy sovet po kompleksnoy probleme "Kibernetika". Voprosy bioniki (Problems of bionics) Moscow, Izd-vo "Nauka", 1967, 79-81

TOPIC TAGS: fish chemical detection, gustation, olfaction

ABSTRACT: Chemoreception plays an important role in the food procuring and defense reactions of many fish. The present study investigated the sensitivity of nine species of fish to different chemical substances of a biological and nonbiological nature. Sensitivity was determined by a cardiographical method based on change of heart rhythmicity under the action of external chemical substance stimuli. The heart beat rate was recorded with an electrophysiological device consisting of an amplifying unit and an oscillograph. The fish were placed into a water filled vessel standing inside a screened box. An electrode was inserted into the body of the fish near the heart. Change of heart beat was observed on the oscillograph. Chemical substances were introduced into the water at the same place so that the fish could not see the experimenter. Findings show that the crucian carp and the common carp can detect acetic acid in a concentration of  $2 \times 10^{-6}$  mg/l and ammonia in a concentration of  $2 \times 10^{-5}$  mg/l. Roach fish and groundling fish can detect an extract prepared from moths in a concentration of 1:2000 and the golden shiner can detect it in a concentration of 1:1500. Olfactory perception of the investigated fish plays a definite role in finding food at close distances. For example, the carp detects an attracting solution in the first 15 sec at a distance of 1-3 cm. Speed and distance of detection apparently depend on the propagation rate of the substance in the water. On the basis of study and literature data on chemoreception of fish, it is noted that taste sensitivity is just as high as olfactory sensitivity.

39.

AUTHOR: Maksimchuk, G. G.; Spivachenko, D. L.; Kuznetsov, S. A.

ORG: none

TITLE: Electrophysiological investigation of a mechanoreceptor under adequate stimulation

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 89-90

TOPIC TAGS: animal, neuron, muscle stimulation, biopotential

ABSTRACT: The electric activity of slowly and rapidly adapting neurons of isolated receptor formations from the second and third ventral segments of the crayfish was investigated under mechanical influence on the corresponding receptor muscles. Various stimuli were applied with a special device (Spivachenko, Maksimchuk, 1965). The fundamental principles of the electric activity of the receptor cell are manifested in the form of unusual hysteresis of the intensity of electric pulsation in response to the active and passive phases of mechanical influence. Certain features of the electric activity of slowly and rapidly adapting neurons under different forms of stretching of the corresponding receptor muscles were identified. It is supposed that the mechanical properties of the receptor muscles themselves are responsible to a specific degree for this manifestation of electric activity. Apparently the properties of dendrites of corresponding neurons also play a role in determining the nature of the impulse activity of receptor cells during mechanical stimulation.

40.

AUTHOR: Malakhov, A. N.; Podlipalin, Yu. D.

ORG: none

TITLE: Some statistical characteristics of electric activity of the sense organs of the lateral line system of fish

SOURCE: AN SSSR. Nauchnyy sovet po kompleksnoy probleme "Kibernetika". Voprosy bioniki (Problems of bionics) Moscow, Izd-vo "Nauka", 1967, 130-136

TOPIC TAGS: fish, biopotential, nerve fiber, signal modulation, probability distribution

ABSTRACT: The threshold of the sense organs of the lateral line system of fish is very low when stimulated by low frequency vibrations, and at the same time these sense organs are characterized by high spontaneous activity. As long as spontaneous activity is a form of fluctuation in the receptor system and determines the threshold value, these two characteristics of the lateral line system are mutually exclusive. To elucidate the contradictory nature of the data, the bioelectric activity of the sense organs of the lateral line system was investigated in nine species of fish (see Fig. 2). A device for producing low frequency oscillations in the water consisted of an electromagnet and a closed air system (see Fig. 1). Impulses were recorded on

a loop oscillograph and processed statistically. Then spontaneous activity of a single nerve fiber of the lateral nerve was studied; also the distribution of impulse repetition rates was investigated and the applicability of Poisson's law of probability was considered. Technically, the lateral line sense organs act as sensors by the nature of their work and can be divided into two groups. Sensors of the first group in measuring any magnitude produce electromotive force. Sensors of the second group transform the measured magnitude into electric parameter changes modulating the electric sinusoidal oscillations, direct current and impulse signals. Findings show that the sense organs of the lateral line stimulated with low frequency vibrations function in such a way that modulation of the impulse signal takes place at the level of the lateral nerve. At this level of the analyzer, the work of the lateral line organ is similar to the work of sensors of the second group. But, unlike the latter, the modulation found in the lateral nerve is not stabilized according to the modulated parameter of the signal, but according to the probability distribution of the modulated parameter. Thus, in the given case, modulation of one's own noise, an impulse signal with a probability distribution of the impulse repetition rate, is observed. Apparently, this method of modulating one's own spontaneous activity is more effective than the method of direct detection and change of signal. Orig. art. has: 8 figures, 2 tables and 2 formulas.

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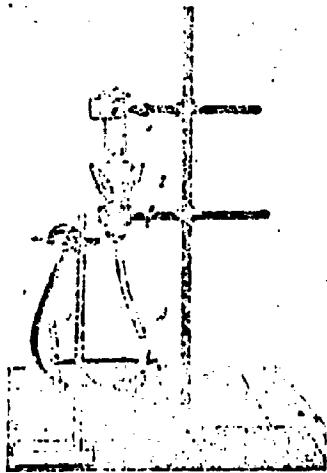
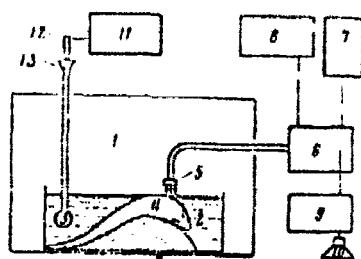


Fig. 1. General view of setup for producing low frequency vibration.

- 1--electromagnet;
- 2--funnel with a rubber membrane in the center of which a ferromagnetic disk is attached;
- 3--a T-pipe with a cock;
- 4--nozzle with a rubber sphere.

Fig. 2. Block diagram of electrophysiological setup.



- 1--scratched chamber;
- 2--vessel with fish (4);
- 3--pulsating sphere;
- 5--electrode system;
- 6--I-BP 1-01 amplifier of biopotentials;
- 7--C 1-19 oscilloscope;
- 8--loop oscilloscope;
- 9--power amplifier;
- 10--dynamic loudspeaker;
- 11--GNCh-1 generator;
- 12--electromagnet;
- 13--funnel.

41.

AUTHOR: Matysyak, Ya.

ORG: none

TITLE: Role of components of complex stimuli in uniting sections of reflex systems into new complexes

SOURCE: Vsesoyuznaya konferentsiya po neyrofizernetike, 3d, Rostov-on-Don, 1967. Problemy neyrofizernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 91-92

TOPIC TAGS: rat, reflex activity, conditioned reflex, behavior pattern

ABSTRACT: In an experimental group of rats, reflexes to complex stimuli were preliminarily developed and elements of these complexes entered into other chains of reflexes which were also developed in the rats. Thus the rats had preliminary experience in the form of different systems of reflexes which had the same elements of stimuli. Then both experimental and control groups were presented with problems of logically uniting separate components of the previously developed conditioned reflexes into a new combination. The results were judged on the first choice of method and the nature of animal behavior in subsequent experiments. Rats which did not have preliminarily developed reactions to complex stimuli were not able to solve

problems of this type. The rats' tactics approached the optimal solution in proportion to frequency of problem presentation. The role of elements of the complex stimulus in uniting sections of the system into new complexes was clarified. The decisive role in this union was played by complexes of movements entering into previously developed systems of reflexes, rather than by random complexes of movements.

42.

AUTHOR: Matyushkin, D. P.

ORG: none

TITLE: Two motor systems of the oculomotor apparatus and their functions in nystagmic movements of the eyes

SOURCE: AN SSSR. Nauchnyy sovet po kompleksnoy probleme "Kibernetika". Voprosy bioniki (Problems of bionics) Moscow, Izd-vo "Nauka", 1967, 387-390

TOPIC TAGS: visual physiology, biopotential, electromyography

ABSTRACT: In his earlier works the author established the dual nature of the oculomotor system characterized by two specialized motor systems: the phase system responsible for rapid eye movements, and the tonic system responsible for slow eye movements. The phase system consists of muscular fibers that conduct excitation, have typical action potentials (2-3 msec duration) for skeletomuscular fibers and are innervated by alpha-motor neurons. The tonic system consists of nerve fibers that do not conduct excitation, have slow action potentials (10-20 msec duration) and are innervated by gamma-motor neurons. An electrographic investigation of the work of the external rectus muscle of the eye in the postrotatory nystagmus and opticokinetic nystagmus was conducted in eight rabbits to learn more about the functions of the phase and tonic systems. Electromyograms were recorded with needle macroelectrodes, one inserted into the venter of the muscle and the other into the muscle tendon. Indices for phase fiber excitation were the characteristic biphasic potentials (2-3 msec duration), and indices for tonic fiber excitation were the slow oscillations of the EMG potentials. The postrotatory nystagmus was induced by rotating the animal ten times on a manually operated centrifuge at 1 rps; and the opticokinetic nystagmus was induced by rotating a cylindrical screen with vertical black stripes around the animal at 15 degrees per second. It was found that the distribution of functions between the phase and the tonic systems in both types of nystagmus is similar. The activity of the muscles in the rapid phases of a nystagmus is always connected with the appearance of short biphasic action potentials in the EMG. But, it should be noted that with realization of the rapid phases, intensification of slow oscillations of the tonic system also takes place. Activation of the tonic system at the time of rapid phases ensures temporary fixation of the eyes in a new position. Activity of the muscles during the slow phases of a nystagmus is characterized by intensification of slow oscillations of the potentials, which develop gradually. Thus, slow phases

of a nystagmus are ensured by the tonic system, and in most cases the phase system does not participate. However, if the slow phases are considerably shortened (accelerated), then as in the case of a postrotatory nystagmus of some animals, there may be an "admixture" of rapid action potentials. So, eye movements characterized by an intermediate speed may be controlled by the combined work of the tonic and phase systems of the oculomotor apparatus.

43.

AUTHOR: Mekhedova, A. Ya.

ORG: none

TITLE: The conditioned food secretory reflex during probability reinforcement

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 96

TOPIC TAGS: dog, conditioned reflex, probability, biologic secretion

ABSTRACT: Many investigations of the principles of the behavior of man and animals in a probability changing environment have been made by applying different modifications of conditioned reflex methods. The author investigated conditioned food secretory reflexes in six dogs in situations when the probability of reinforcement of a conditioned stimulus with two portions of food (5 and 50 grams) was equal to unity or less (0.25, 0.5, 0.75), but the sequence of obtaining either quantity of food was random. During transition from constant to probability reinforcement, two types of reaction were noted. In the majority of animals the magnitude and latent period of the conditioned reflexes were average in comparison with their reactions during constant reinforcement with a large or small portion of food. In some of the animals the conditioned reflexes proved maximal in experiments with probability reinforcement. Statistical evaluation of the probability of reinforcement thus appears even on the level of conditioned vegetative reflexes. The maximal reaction under conditions when the animals did not have an opportunity to realize an active choice of the greatest reinforcement shows that the development of emotional tension can be considered the consequence of instability of a probability stereotype.

AUTHOR: Katsubilis, N. A.

ORG: none

TITLE: The mechanism of inhibition of the negative emotional reactions of fear and rage in cats

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 107-108

TOPIC TAGS: cat, emotion, bioelectric phenomenon, self organization, nerve fiber

ABSTRACT: Negative emotional reactions were induced in cats by natural stimuli or electric stimulation of various parts of the limbic system with electrodes implanted in the brain. It was demonstrated that: a) the thresholds for inducing the reactions strongly increased on a background of positive emotional reaction; b) a sleepy condition of the animal increased the reaction thresholds of the negative emotional reactions of fear and rage; c) a sleepy condition induced by electric stimulation of the centromedial and other nuclei of the optic thalamus increased the reaction thresholds, weakened their intensity, and accelerated their consequences; and, d) conditioned signals of stimulation of the above thalamic nuclei increased the reaction thresholds. The mechanism of self-regulation appearing in the development of the sleepy state causes inhibition of the emotional reactions of fear and rage. The nuclei of optic thalamus include fibers which both excite and inhibit activity of the neurons. The fibers are selectively excited with the appropriate parameters of stimulation and send exciting or inhibiting impulses at different times to the neurons at the centers of the negative emotional reactions of fear and rage.

45.

AUTHOR: Podvigin, N. F.

ORG: none

TITLE: Comparative investigations of on and off responses of the retina

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 116-117

TOPIC TAGS: frog, electroretinography

ABSTRACT: Clarification of reasons for differences in the behavior of the alpha and beta waves of the electroretinogram is important for understanding the mechanisms of the on and off systems of the retina. Investigations were conducted by a microelectrode technique on the isolated eye of the frog to determine retinal response. With increase in exposure to a flash of light, the amplitude of the alpha wave (the response to switching off) at first increases to a maximal value and then begins to decrease. The amplitude of the beta wave (the response to switching on) increases

photically with invariance in the brightness of the flash. A hypothesis was introduced that if light stimuli on a dark background are used to investigate an on system then dark stimuli on a light background must be used in the case of an off system. The experiments then demonstrated that the alpha wave monotonously increases with increase in exposure, i. e. when dark stimuli of decreasing intensity are presented. The latent period of the alpha wave has minimal significance when the amplitude of the response is maximal. Thus, the beta and alpha waves behave identically during change in illumination if a method of presenting light stimuli is used which corresponds to the normal operating conditions of the system.

AUTHOR: Brzoznikova, N. V.

CAT: none

TITLE: Invariance of visual image identification in fish, dogs, and apes

SOURCE: Vsesoyuznaya konferentsiya po neirokibernetike, 3d, Rostov-on-Don, 1967. Problemy neirokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Kostovskogo univ., 1967, 124

TOPIC TAGS: animal, psychometry, form recognition

ABSTRACT: The formation of complex characteristics and the degrees of their invariance in animals with brains of different complexity were investigated in goldfish, dogs and lower apes (*hamadryas* baboons). Images of visual objects which the subjects had been trained to recognize were varied by changing the color and distorting background contrast, by replacing outlined figures with solid ones and solid figures with outlined ones, and by certain deformations of the outline. Results demonstrated that there are no differences among fish, dogs, and apes in speed or clarity of differentiation evaluation from experiment to experiment. However, substantial differences were discovered between fish on one hand, and dogs and apes on the other, in analysis of differentiation of the transformed images of stimuli. These differences were determined by the different degrees of invariance of the complex characteristics according to which classification of objects was performed. Change in dimensions of the images did not affect accuracy of discrimination by fish. This provides a basis for supposing that in the fish visual analyzer each variant of the image is described by a set of characteristics which prove useless for identification of another variant. The process of identification in fish can be considered in this case as the comparison of presented images with a standard one. Differentiation of the same visual objects by dogs and apes indicate a wider degree of generalization which ensures discrimination of transformed images as well as of those in which the animals were trained. These data make it possible to form a conclusion about the gradual development of invariance in the evolutionary order.

47.

AUTHOR: Rogovskiy, P. Ya.

ORG: none

TITLE: Morpho-functional types of the pelvic girdle skeleton of mammals

SOURCE: AN SSSR. Nauchnyy sovet po kompleksnoy probleme "Kibernetika". Voprosy bioniki (Problems of bionics) Moscow, Izd-vo "Nauka", 1967, 588-592

TOPIC TAGS: animal, skeletal mechanics, morphology

ABSTRACT: A comparative study of the anatomic structure was conducted on a total of 116 pelvic girdles and sets of bones of a group of 55 species of mammals with rigid horizontal or nearly horizontal pelvises, typical of the insectivora, monotremata and edentata, hinged pelvises typical of the dog family, and resilient pelvises typical of hooved animals. The purpose of the study was to determine the influence of various types of supporting systems on the shape of pelvic girdles and individual pelvic bones. Values of the ilium and sacrum indices, defined as the ratios between the ilium perimeter and length and between the maximum sacrum width and length, are given for a group of 43 species of the monotremata, insectivora, edentata, hare family, rodents, carnivora, and ungulates. These indices support the correctness of the division of pelvic girdles into the three morphological groups. Characteristically, the values of the ilium index are highest (2.06-3.58) in the monotremata, insectivora, and edentata which show little motion and use full feet for support, gradually decrease (to 1.06-2.30) in the rodents and carnivora, partially using their toes for motion, and are lowest (0.47-1.14) in hooved animals which need shock absorption. Thus, evolution of a rigid pelvis into a hinged pelvis, and finally into a resilient pelvis is revealed in this group of animals, by the weight of the body, the method of support, and the speed of motion. Orig. art. has: 1 figure and 1 table.

48.

AUTHOR: Shevelev, I. A.

CRG: none

TITLE: Temporary shaping of the visual system afferent flow

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 166

TOPIC TAGS: cat, visual porception, biopotential, visual physiology

ABSTRACT: Temporary shaping is one of the most important operations in signal discrimination, contributing to reliable separation of signals from noise and to precise determination of the moment of their arrival in a section of the analyzer. It was previously demonstrated (Shevelev and Hicks, 1965) that signal synchronism increases substantially in proportion to its movement along the straight optic tract of the anesthetized cat. This can be caused by multiplication and lateral overlap of vertical connections between layers, and also by desynchronization of the signal in the retina due to dispersion according to the size of the functioning receptive fields. On the basis of this model, investigations are now being conducted of strength curves and time summation of induced potentials of different sections of the cat visual system under light stimulation of the retina and electric stimulation of the optic nerve. Comparison of this experimental data with the basic characteristics of signal transmission in the auditory system and with known data about the adaptation characteristics of neurons on various levels of analyzer systems can lead to an explanation of mechanisms for signal processing in the visual analyzer in the first moments of time after stimulation.

42.

AUTHOR: Slobin, G. I.

CAG: none

FILE: Some organization principles of the auditory system in mammals

SOURCE: All Sov. Nauchnyy sovet po kompleksnoy problem "Kibernetika". Voprosy bioniki (Problems of bionics) Moscow, Izd-vo "Nauka", 1967, 391-397

TOPIC TAGS: animal, audition, acoustic property

ABSTRACT: The work examines the organizing and transforming systems of the external and middle ear. Observations show that sound pressure on the upper, middle and lower parts of the concha in different animals is not the same. For instance, in rabbits and pigs the larger part of the concha does not participate in regulating the tuning frequency of the external ear nor in amplifying sound, but appears to perform a heat regulating function. In the process of improving the acoustical orientation of terrestrial animals, the development of a more complex inner surface of the concha is observed with additional valves, increase in size and independent movement of parts. Many animals (porcupine, ungulates and carnivores) cannot change the form and volume of the concha and its internal valves cannot move independently. Under these conditions the concha becomes a system with invariable acoustic parameters. With ability to change the form of the concha and independent movement of separate valves, the possibilities for frequency tuning of the system and regulation of sound intensity transmitted to the middle ear increase significantly. For mammals with exceptionally acute hearing as in the case of some rodents, insect eaters and bats, the concha is characterized by a growth at its base and sometimes the development of a "hearing sac" (see Fig. 2a, b). In water forms of life (whales, seals and walruses) the size of the concha is reduced. In animals with high sensitivity to high frequencies, particularly to ultrasonic frequencies (bats, shrews and small rodents), the tympanic membrane tends to be more rounded and smaller in size and the weight and size of the auditory ossicles tend to be smaller. The study and classification of middle ear cavities in mammals show that the spongy type of cavity is characteristic of animals living in close environments (water, underground, snow or tundras) or animals living in hard and rocky substrates. The chamber type of middle ear cavity in which the tympanic membrane is divided into several chambers by thin bone septums is characteristic of gophers and dormice. In studying the acoustic properties of sponge type and a chamber type middle ear cavities on models, it was found that both types are acoustic absorbers sharply reducing the intensity of sound amplification. A survey of the basic groups of mammals shows a tremendous variety of mechanisms for amplifying tissue and bone conductivity of sound. The development of these mechanisms appears to be closely related to evolution. Tissue conductivity particularly, and also bone conductivity of sound are characteristic features of hearing of the lower vertebrates. Orig. art. has: 3 figures.

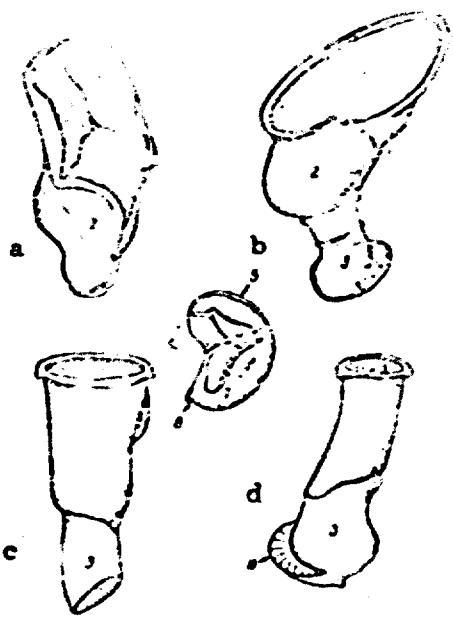


Fig. 2. Special structural features of the external ear of mammals.

a--porcupine;

b,c.--shrew;

d--muskrat;

e--mole;

1--concha; 2--"hearing sac"; 3--external hearing passage; 4--disc shaped growth on the inner ring of the external hearing passage; 5--free rim of the concha; 6--pocketlike valve (plica principalis); 7--saclike antitragus; 8--opening of the external hearing passage.

PL.

AUTHOR: Skripnikov, A. G.; Krol', V. N.

CRG: none

TITLE: Study of the structural-functional units of the visual analyzer

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 139-140

TOPIC TAGS: cat, visual perception, biopotential

ABSTRACT: A special procedure was developed for local photostimulation of the eyes which makes it possible to place light spots of arbitrary form and dimension on the retina under conditions of direct control. The input signal can be varied within broad limits by changing the coordinates of the spots and the brightness and duration of the stimulator. Investigations were conducted on the awake and relaxed cat by macroelectrode and microelectrode recordings of induced potentials of the lateral geniculate body and of the cortical visual areas. Data on the amplitude and other parameters of the induced potential indicate the limiting conditions of the visual system under normal diffuse photostimulation. Increase in the dimensions of the light spot above 5-10 degrees spreads the induced potential through the entire visual cortex.

The relationship of the amplitude of the induced potential to the brightness of the stimulus has a relay nature. Consequently, basic functional relationships are disrupted in a zone of high saturation. This saturation is characteristic of diffuse photoflashes. Data were obtained on the relationship of parameters of the induced potential to the area of the spot, on the coefficients of transformation of the visual field on higher sections of the visual analyzer, and on other characteristics of the structural-functional units.

51.

AUTHOR: Stepanov, A. S.

ORG: none

TITLE: Functional significance of the waves in the frog electroretinogram

SOURCE: AV SSSR. Nauchnyy sovet po kompleksnoy problems "Kibernetika". Voprosy bioniki (Problems of bionics) Moscow, Izd-vo "Nauka", 1967, 405-411

TOPIC TAGS: frog electroretinography, visual physiology, biopotential

ABSTRACT: The relationship between the electroretinogram (ERG) and the electrogram of the optic nerve recorded simultaneously in the frog was investigated. In 25 experiments conducted on frogs with damaged spinal cords and brains, action potentials of the optic nerve were recorded near the chiasm 4-5 mm from the eye, and the ERG was recorded from the cornea of the eye with noninsulated platinum electrodes. Nerve impulses were amplified by an U3P1-01 amplifier, and the ERG were amplified by a direct current amplifier; and, both processes were recorded on an H-102 oscillograph. Light stimuli were applied in the form of single light flashes of 0.4-0.6 sec duration, and maximum light illumination was about 600 lux. Study data established the following sequence of response reactions of the peripheral link of the visual analyzer (see Fig. 2). In response to a light stimulus, wave a of the ERG whose latent period is 20-40 msec (mean of 33 msec) appears first. In 50-90 msec (mean of 65 msec) action potentials appear in the visual analyzer; prior to their appearance, a period of spontaneous activity inhibition is generally observed. At about the same time (60-100 msec) wave b of the ERG appears. With switching off of light, wave d appears whose latent period is 25-50 msec (mean of 38 msec), and it is followed by action potentials of the optic nerve with a latent period of 20-70 msec (mean of 44 msec). Thus, in response to a light stimulus, the discharge of impulses in the optic nerve of a frog appears at the same time as the b and d waves of the ERG. However, further development of these waves is considerably delayed in relation to the discharge of nerve impulses. Experiments with light and dark adaptation of animals show that under certain conditions, significant changes of the a, b and d waves of the ERG can be obtained without any reflection of these changes in the electric activity of the optic nerve. It is concluded that the "generator potential" evoking the discharge of impulses in the ganglionic cells constitutes only a small part of waves b and d. The main part of these waves which is highest in voltage does not participate directly in the information transmission process. Crig. art. has: 4 figures and 1 table.

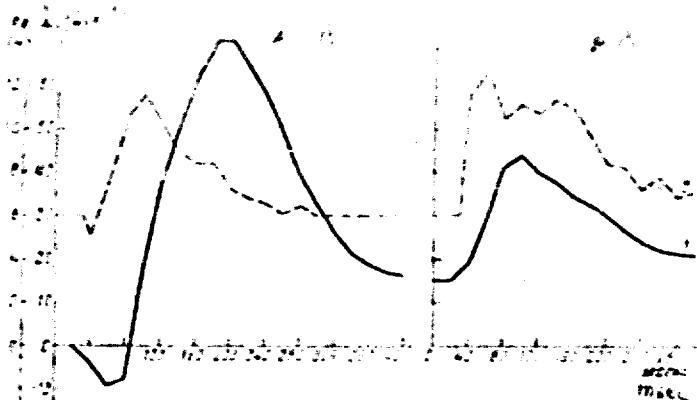


Fig. 2. relation between time changes of the electroretinogram and the electrogram in response to switching on of light (A) and switching off of light (B); 1—amplitude of the electroretinogram (mV); 2—amplitude of the electrogram (mV).

32.

AUTHOR: Trubachev, V. V.; Vasilevskiy, N. N.

ORG: none

TITLE: An EEG learning model with probability reinforcement

SOURCE: Vsesoyuznaya konferentsiya po neirokibernetike, 3d, Rostov-on-Don, 1967. Problemy neirokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 150-151

TOPIC TAGS: rabbit, learning process, EEG, probability, conditioned reflex, biologic model

ABSTRACT: An electroencephalographic study was made of the role of probability organization of a significant stimulus on conditioned reflex models developed in curarized rabbits under varying frequencies of reaction reinforcement (100%, 80-90%, 50%, and less than 30%). Reinforcement was obtained both in a random and in a stereotyped order. The expressiveness of EEG indices such as desynchronization of the EEG, synchronized rhythms, and induced responses was taken into account. With stereotyped reinforcement of each second stimulus at equal time intervals, distinct EEG reactions were observed during action of the unreinforced stimulus. Statistically reliable differences in EEG changes for a conditioned reinforced and nonreinforced signal were not observed during nonstereotyped reinforcement (less than 50%). Some increase in frequency and duration of reactions in response to a stimulus is noted in the EEG at the 80-90% level of reinforcement. The degree of EEG activation was on the same level for 100% and stereotyped 50% reinforcement. However, the EEG activation reaction was more stable and somewhat more prolonged in the period of extinction of the conditioned reaction for stereotyped 50% reinforcement than for 100% reinforcement. Not only the number of coincidences of conditioned and reinforced signals but also the entropy of the system of stimuli, which carries additional information accelerating development of the temporary connection, is important in the process of animal learning.

14.

AUTHORS: Vinogradov, Ya. I.; Gazeiko, O. S.; Pitova, L. K.; Bronshtejn, A. A.; Chelkondashkiy, L. A.

CIT: none

TITLE: Basic principles of the sensory organization of the gravitation organ

SOURCES: Vsesoyuznaya konferentsiya po neirokibernetike, 3d, Rostov-on-Don, 1967. Problemy neirokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 22-23

TOPIC TAGS: vestibular apparatus, animal physiology, adaptation

ABSTRACT: A special peripheral sensor was formed in the process of animal evolution during different geological periods. This sensor clearly reacts to rectilinear and radial accelerations and senses changes in the position of an organism in the gravitational field. In vertebrates the sensor consists of the membranous labyrinth of the inner ear, including the maculae utriculi and maculae sacculi with their otoliths. In invertebrates it consists of otoliths or the "pebbly" statocyst of crustaceans and cephalopod mollusks. Comparison of the organ, cellular, and ultrastructural organization of the gravitation organ of vertebrates, crustaceans, and cephalopod mollusks demonstrates that, in spite of differences in their phylogeny, there is a striking morphological and functional parallelism, especially in the primary sensory mechanisms, which we assume is the result of a similar evolution of function. The gravitation organ evidently was formed by natural selection under the influence of physical factors of gravitation which were equally compulsory for representatives of Protostomia and Deuterostomia. Comparison of the organ, cellular, and ultrastructural organization of the gravitation organs mentioned above permits a closer understanding of the primary function mechanisms of their receptor elements, forms a basis for their simulation, and leads to new concepts in physical analysis of the gravitational field itself.

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AUTHOR: Voronkin, N. F.; Kozhevnikov, S. N.; Manziy, S. F.; Mel'nik, E. P.; Pryakhin, I. M.

ORG: none

TITLE: Reliability of the locomotor supporting system of mammals

SOURCE: AN SSSR. Nauchnyy sovet po kompleksnoy probleme "Kibernetika". Voprosy bioniki (Problems of bionics) Moscow, Izd-vo "Nauka", 1967, 572-578

TOPIC TAGS: animal, skeletal mechanics, bone, elastic modulus, compressive strength, hardness, mechanical fatigue

ABSTRACT: The elastic modulus, the compression strength, the hardness, and fatigue were investigated in bone tissues selected from a total of more than 2000 bone samples from the forelegs and hind legs of bovine animals, pigs, domestic horse, and Przheval'skiy horse. Values of  $20-30 \text{ kN/mm}^2$ , proportional to the specific weight of the sample, were obtained for the compression strength of cylindrical samples with a height/diameter ratio of 2:1, using a universal testing machine with loads up to 5 tons. Tensiometers with a 20 mm base were applied bilaterally to samples for measuring the elastic modulus and hardness. Bone fatigue was studied under variable tensile loads up to 6.1, 5.0, 3.75, and  $2.0 \text{ kN/mm}^2$ . Longitudinal and cross sectional anisotropy was established in the physical and mechanical properties of tissues of tubular bones. The hardness and compression strength of these bones were generally lower in their distal ends than in proximal ends, and the mechanical behavior of the tubular bones of forelegs suggested their greater capacity for converting a fraction of the kinetic energy of motion into the potential energy of deformation than that of the skeletal elements of hind legs. An analysis of the fatigue curves indicated that numbers of cycles causing failure were smaller under higher loads. It is concluded that fatigue of the bone tissue determines the reliability of the skeletal locomotor system of domestic mammals under continuous prolonged dynamic loads. It is also believed that the efficiency of this system and the strength of the skeleton sharply decreases when loads are not applied for a long period of time. Orig. art. has: 2 tables and 2 figures.

DD.

AUTHOR: Yefremova, T. N.; Trush, V. D.

ORG: none

TITLE: Investigation of electrocorticogram spectra of the rabbit visual region using a microelectrode lead

SOURCE: Vsesoyuznaya konferentsiya po neirokibernetike, 3d, Rostov-on-Don, 1957. Problemy neirokibernetiki (Problems of neurocybernetics); referaty dokladov Konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1957, 45

TOPIC TAGS: rabbit, electrocorticogram, cerebral cortex, visual perception, EEG, frequency characteristic

ABSTRACT: A frequency spectrum of an electrocorticogram (in a range from 1 to 50 cps with a 0.25 cps step) was investigated in different layers of the rabbit visual cortex using a microelectrode with a tip diameter of 2 to 5 microns. The spectrum was determined in the background at 5 sec intervals during stimulation with rhythmic light and during the aftereffect. The spectral function was computed on a general purpose computer as a transformation from the autocorrelation function. Computer input of the electrocorticogram was done automatically with motion picture film. The frequency spectrum of the electrocorticogram recorded with the microelectrode is very similar (according to composition of frequencies) to an EEG spectrum recorded with a 0.3 mm diameter electrode on the surface of the visual cortex. Frequencies from 1 to 10-12 cps prevail in both cases. The noise level, i.e. the uniformly distributed frequency components up to 50 cps, is the same in the EEG and in the electrocorticogram. The involvement reaction in all layers of the cortex is clearly expressed in the first five seconds of stimulus action. In this period the reaction has a strictly narrow band character. The frequencies from 1 to 10 cps are suppressed, but the noise level does not change. After ten seconds of stimulus action, previously suppressed rhythms characteristic of the background activity begin to appear. The involvement reaction is accompanied by appearance of harmonics of a lower and a higher order. The harmonics of the higher order are considerably less expressed than the basic harmonics. The investigations confirm: 1) absence of a substantial difference in background between the frequency spectra of the EEG and the electrocorticogram recorded with microelectrodes from the surface and deep layers of the cortex; and, 2) presence in the electrocorticogram of an involvement reaction on different levels of the cortex which appears more rapidly and is more clearly expressed than in the EEG.

20.

AUTHORS: Zakharova, L. M.; Litvintsev, A. I.

ORG: none

TITLE: A study of the activity of a skeletal muscle of an animal under conditions of closing of its artificial feedback

SOURCE: AN SSSR. Nauchnyy sovet po kompleksnoy probleme "Kibernetika". Voprosy bioniki (Problems of bionics) Moscow, Izd-vo "Nauka", 1967, 359-368

TOPIC TAGS: cybernetics, bionics, mouse, muscle stimulation, reflex activity, biopotential, electromyography, probability

ABSTRACT: Artificial conditions are created for finding the minimum electrical stimulation of one skeletal muscle of an animal. Minimum muscle tension corresponded to minimum stimulation. It was assumed that the animal strived for minimum stimulation and was able to organize the search activity of the muscle. About 250 experiments with tens of white mice showed they could seek minimum stimulation. Continuous periodic oscillations of the control action near values corresponding to the minimum of the extremal characteristic were observed. It is shown that the search for minimum painful stimulation can be explained on the basis of the search hypothesis. Special experiments confirmed the hypothesis on the left-to-right search. Orig. art. has: 16 figures and 1 formula.

RUSSIAN MODELS OF LIFE PROCESSES

57.

MATHEMATICAL MODELING OF LIFE PROCESSES (USSR)

The All-Union Conference on the Problems of Modeling Life Processes organized by the Scientific Council on the Complex Problem "Philosophical Problems of Contemporary Natural Sciences", the Central Bureau of Philosophical Seminars, and the Institute of Philosophy of the Academy of Sciences USSR and held in Moscow from 17 to 18 March 1966 was attended by some 450 Soviet scientists from Moscow, Leningrad, Novosibirsk, Postov, and other cities.

In his introductory remarks, B. Ye. Bykhovskiy stressed the importance of the mathematization of biological processes to the progress of biological sciences. He distinguished three basic stages of mathematization: 1) determination of the quantitative characteristics of biological processes; 2) choice of biological systems to be considered as elementary; and 3) development of mathematical theory (the mathematical models) to explain the nature of other biological processes in terms of elementary ones. A. A. Lyapunov pointed out the enormous power of mathematical methods in solving the problem of the multilevel structure of living organisms. He gave a detailed account of studies carried out in that direction in the Siberian Branch of the Academy of Sciences USSR, in particular, a logical model of "operons" which is considered as a certain kind of "atoms" of biological system activity (V. A. Ratner) and of simplified "machine" models of life processes for population genetics (O. S. Kulagina). The problem of choosing the simplest objects for mathematical modeling was analyzed at the conference. M. L. Tsetlin and A. A. Malinovskiy pointed out embryogenesis as a particularly favorable object in this respect. I. A. Akchurin proposed application of the general mathematical theory of categories and functors to the study of multilevel structures of life processes. The paper by the recently deceased N. A. Bernshteyn stressed the necessity of developing entirely new chapters of biomathematics for describing particular biological processes. The theory of well organized functions (L. U. Gel'fand and co-workers are working on this theory) is indicated as one of such new chapters. V. L. Puzhkov reported on spiralization and despiralization in protein and nucleic acid molecules in processes of the embryogenesis and neural activity and stressed the need of introducing new and profound theoretical concepts based on such chapters of modern mathematics as topology and the theory of random processes into biology. G. V. Gershuni

and G. B. Nikolskiy pointed out that development of the mathematical theory of biological processes requires modification of the established concepts of biology; however, they advise that this be done very carefully. Panel discussions were held on presented problems. In particular, the applicability of the second law of thermodynamics to biological systems was the subject of heated discussions.

[LK]

SOURCE: Akchurin, I. A. Mathematical modeling of life processes (All-Union conference in Moscow). IN: Akademiya nauk SSSR. Vestnik no. 7, 1966 93-95.

TOPIC TAGS: mathematical modeling, biological process modeling, All Union conference

:8.

AUTHOR: Baybikov, Ye. V.

ORG: none

TITLE: Model design of the amplification and conversion mechanism of input signals in the receptors of sense organs

SOURCE: AN SSSR. Nauchnyy sovet po kompleksnoy probleme "Kibernetika". Voprosy bioniki (Problems of bionics) Moscow, Izd-vo "Nauka", 1967, 30-36

TOPIC TAGS: human sense, signal reception, medical research, bionics, nervous system

ABSTRACT: An electronic circuit has been designed for simulating the input signal amplification and conversion mechanism in human sense organ receptors. The circuit simulates closely the action of actual receptors and can be used for sense phenomena studies and for developing artificial sense receptors. The main circuit element is a thyratron blocked by a total voltage made up of a base voltage ( $V_b$ ) and a voltage of a charged capacitor ( $V_c$ ). As the capacitor slowly discharges, reducing  $V_c$ , the thyratron fires. At firing, the thyratron is extinguished and the capacitor is recharged to  $V_c$ . Thus there exists a constant low frequency signal corresponding to the spontaneous activity of receptors. With an increased  $V_b$ , the signal frequency increases, restoring a  $V_c$  sufficient to compensate  $V_b$ , restoring the original circuit to a stable unbalance state. This action corresponds to receptor adaption. The circuit, just like the receptor, responds only to sharp input signal changes. The circuit will respond to a light increase or decrease, if connected to a photoresistor or to a regular resistor of a voltage divider, respectively, paralleling the paired action of receptors responding to signal changes of only one sign. Thus the circuit operates in a steady unbalance state highly sensitive to input signal changes, and producing interference-free output signals with a repetition frequency proportional to the input signal change. Orig. art. has: 4 figures.

59.

AUTHOR: Berezkin, A. G.; Kozhevnikov, S. N.; Manziy, S. F.; Pryakhin, I. M.

ORG: none

TITLE: Joints of the extremities of mammals as damping devices

SOURCE: AN SSSR. Nauchnyy sovet po kompleksnoy probleme "Kibernetika". Voprosy bioniki (Problems of bionics) Moscow, Izd-vo "Nauka", 1967, 582-588

TOPIC TAGS: dog, skeletal mechanics, X ray study

ABSTRACT: X-ray studies of a total of 32 joints of dogs filled with a contrast liquid, and an examination of a total of 14 frozen joints and of latex casts for a total of 21 joints showed a nonuniform distribution of the synovia in the interspaces between bones of a joint, with synovial accumulations predominant in areas free of a close contact between bones. It was observed further that there was invariably a synovial interlayer, rather than a direct contact, between the bone surfaces of joints in a relaxed state and that increasing pressure gradients developing in different portions of joint cavities during bending and unbending motions exerted a damping effect on these motions. A study of a group of 8 dogs revealed only synovia traces in the joints of dogs immobilized for 12 months, and 125-225 and 369-615 m<sup>2</sup> synovia in the joints of control dogs and dogs given running exercises for 12 months, respectively. The amounts of synovia in the joints of a group of hooved animals and its specific weight, viscosity and total nitrogen content are given. The theory that a negative pressure constantly keeps the bones of joints in animals in direct contact is dismissed. Orig. art. has: 1 figure and 3 tables.

60.

AUTHOR: Bernshteyn, V. M.

ORG: Central Scientific Research Institute for Prostheses and Prosthesis Construction, Moscow (Central'nyy nauchno-issledovatel'skiy institut protezirovaniya i protezostroyeniya)

TITLE: Model for an electric signal from a group of muscle fibers

SOURCE: Biofizika, v. 12, no. 6, 1967, 1059-1063

TOPIC TAGS: electronic simulation, pulse signal, muscle stimulation, biologic model

ABSTRACT: The study involved a bipotential derived from a group of muscle fibers of one motor unit; a model was sought for the formation of a summary signal which would elucidate some features of the motor unit signal impulse. The model presented gives a mathematical expression for the basic parameters of the impulse itself and those of the complex signal (lead of bipotentials off the surface). The basic formula for voltage of the latter was

$$U_A(t) = \sum_{i=1}^{n-1} U_{ai}(t - \theta_i), \quad (1)$$

where  $U_B$  is the voltage of the fiber pulse signal,  $n$  the number of fibers recording in the motor unit, and  $\theta$  the start of fiber impulse activity. Tests in denervated muscles showed that the fiber signal usually has 2 or 3 peaks with varying polarity (2 or 3, rarely monophasic) approximating those found for a volume conductor. On this basis formulas were developed for 2 and 3 phasic impulses of the motor unit and for asynchronous operation; these were simplified to yield (10) and (12), the latter for asynchronicity

$$\overline{U}_A(t) \approx -n A_1 t e^{-\frac{t}{B_1^2}} \quad (10)$$

$$\overline{U}_A(t) \approx n e^{-\frac{t}{B_1^2}} \left[ A_3 \left( \frac{2}{B_3^2} t^2 - 1 \right) - A_4 t \right]. \quad (12)$$

where  $A$  and  $B$  are coefficients depending on  $U_B$  and  $\phi$  (scalar potential Gaussian curve). Results coincided with myographic values. The energy spectrum of the motor unit impulses calculated according to these and other formulas also coincided with the experimentally correlated function of muscle biocurrents. Another approximating formula is presented for the case where impulses of simultaneously acting motor units have different parameters. Orig. art. has: 20 formulas and 5 figures.

61.

AUTHORS: Fraynes, S. N.; Svechinskiy, V. B.

ORG: none

TITLE: Principles of organization of complex biologic control systems

SOURCE: AN SSSR. Nauchnyy sovet po kompleksnoy probleme "Kibernetika". Voprosy bioniki (Problems of bionics) Moscow, Izd-vo "Nauka", 1967, 287-292

TOPIC TAGS: bionics, cybernetics, algorithm, biologic model, mathematic model, homeostasis, automatic control, automatic control system, physiologic parameter

ABSTRACT: The problem of studying the mechanism of interaction of the principles of centralization and autonomy is examined, and a hypothesis is proposed based on the notion of the dialectic unity of these principles. The control system of the physiologic processes in the organism consists of three hierarchically subordinate levels (see Fig. 1). An algorithm and circuit have been proposed for seeking optimal conditions, and experimental check of the algorithm on a computer, where the internal medium (object of optimization) had ten variables, showed its efficiency.

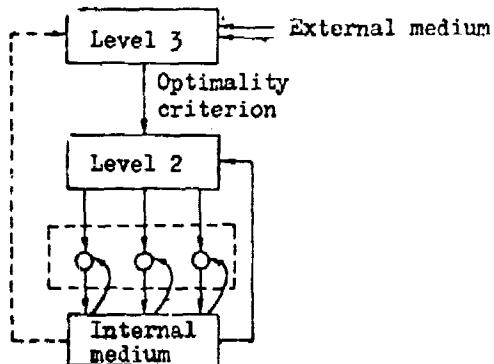


Fig. 1. Hierarchical structure of control system

Orig. art. has: 1 formula and 3 figures.

62.

AUTHOR: Chubarov, A. V.

ORG: none

TITLE: Some questions on the structural-functional simulation of biologic systems

SOURCE: Vsesoyuznaya konferentsiya po neirokibernetike, 3d, Rostov-on-Don, 1967. Problemy neirokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 162-163

TOPIC TAGS: biologic model, analog computer system, computer simulation, brain, biopotential

ABSTRACT: It was demonstrated that the construction of structural-functional models, which are analogs of initial systems in expanded conditions of behavior, cannot be done on linear electronic simulating machines. However, these models can be constructed using elements of nonlinear analog technology which simulate the zone of insensitivity, limitations, the moment of dry friction, relay nature, and free play, and which realize functional transformation, etc. In addition, simulation of complex aspects of the behavior of biologic systems such as adaptation is apparently impossible without applying nonlinear passive or active elements. Models which are a structural-functional set of elements with lumped and distributed parameters should be considered as the next step in developing an apparatus for simulation of biologic systems. The author presents a procedure for construction of such a model, which is a structural-functional analog of certain functionally connected brain formations. The model reproduces in sufficient detail a picture of the bioelectric behavior of the brain on the functional level in a significant range of internal states and under certain forms of external influences.

63.

AUTHOR: Chupakov, A. G.

ORG: none

TITLE: Experimental investigation processing in an electronic model of an auditory analyzer receptor

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d. Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 164-165

TOPIC TAGS: biologic model, electronic simulation, audition, nerve, acoustic signal

ABSTRACT: Aspects of the transformation of input information were investigated in an experimental model of an auditory analyzer receptor, in which certain features of the transformation of an acoustic stimulus into nervous activity were taken into account. Investigation of the amplitude and phase frequency characteristics of the model experimentally confirms a hypothesis about perception of high frequencies according to a place principle and of low frequencies according to a principle of volleys. The effect on the model of complex signals of the modulated and nonmodulated broad band noise type was studied, and suppositions were made about the nature of separation of these signals. The receptor's role was established in the formation of certain psycho-acoustic phenomena, such as the effect of masking of curves of equal loudness. It was concluded that decline in perception of high frequencies depends on features of the transmission of sound in the middle ear. The same is true of low frequencies, but in the cochlea. Experiments with the model demonstrated the important role of the receptor in perception and transformation of signals and led to a conclusion about the nature of information entering the neuron structure.

64.

AUTHOR: Degtyar, V. U.

ORG: Institute of Automation and Telemechanics, Academy of Sciences SSSR (Institut Avtomatiki i telemekhaniki Akademii nauk SSSR)

TITLE: Modeling in physiology of the nervous system

SOURCE: Zhurnal vysshey nervnoy deyatel'nosti, v. 16, no. 1, 1966, 82-87

TOPIC TAGS: nervous system, cybernetics, anatomic model, cell physiology

ABSTRACT: The author proposes the working hypothesis that elementary functional processes of neurons occur on the molecular level. Each macromolecule is then viewed in a set of essential coordinates in such a way that the smallest change in the set would destroy these molecules. Under continuous outside influences, these molecules try to preserve the values of their coordinates around a certain point called equilibrium. The hypothesis is limited to outside forces of slightly larger energies than the energy of activation, but of the same order of magnitude. It is supposed that the macromolecules possess an inner mechanism which utilizes the dissociation energy of all inessential coordinates of the system, which by necessity are weaker than the essential ones, to preserve the essential coordinates around a point of equilibrium. This enables the molecule to preserve its entity under higher energies than it could without such a mechanism. Thus the hypothesis leads to the point that macromolecules tend to compensate for the destructive forces of accidental thermal collisions by interaction with other molecules. This, however, occurs to a limited extent only, and the author introduces a concept of "fixed channels" for the mechanism of compensation. Several theoretical and practical cases are introduced to support these ideas. Experimental work resulting from this model will be published separately. [14]

65.

AUTHOR: Dymerskiy, V. Ya.; Belik, Ya. Ya.

ORG: none

TITLE: The simulation of perceptive processes

SOURCE: Vsesoyuznaya konferentsiya po neirokibernetike, 3d, Rostov-on-Don, 1967. Problemy neirokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 39

TOPIC TAGS: visual perception, mathematic model, automatic control parameter

ABSTRACT: Evaluation of distance from specific objects and evaluation of change in distance has decisive significance in controlling moving systems. The apparent velocity of objects, their apparent size, clearness of discrimination, and the inclination of the sighting angle are the basic parameters according to which this evaluation is made. Analytically the relative change in the angular velocity of the points of a flat object during movement of the observer perpendicularly to its surface is expressed by the formula:

$$\frac{\Delta\omega}{\omega} = \frac{\Delta v}{v} - \frac{\Delta h}{h} + (2 \ln \sin 2\beta).$$

$\frac{\Delta\omega}{\omega}$  is the threshold change of the angular velocity of the points of the flat object with corresponding change in the velocity of the observer's movement, of his distance from the plane, and of the sighting angle. For a tracking sighting the formula has the form:

$$\frac{\Delta\omega}{\omega} = -2 \frac{\Delta h}{h}.$$

For a sliding sighting the formula is expresses as:

$$\frac{\Delta\omega}{\omega} = - \frac{\Delta h}{h}.$$

Hence it follows that the precision of evaluation of change in distance by means of change in the apparent velocity is two times greater for the tracking sighting model than for the sliding sighting model. The models described can be used for psychological evaluation of a field of vision suitable for control of certain kinds of moving systems.

DO.

AUTHORS: Fukshanskiy, L. Ya.; Yuzefovich, G. I.

ORG: none

TITLE: A mathematical model of the time-reading mechanism in biological objects (insects, plants)

SOURCE: AN SSSR. Nauchnyy sovet po kompleksnoy probleme "Kibernetika". Voprosy bioniki (Problems of bionics) Moscow, Izd-vo "Nauka", 1967, 315-322

TOPIC TAGS: bionics, cybernetics, mathematic model, biologic model, insect, plant metabolism, clock, differential equation, nonlinear differential equation, biologic metabolism

ABSTRACT: The available data on the biological clocks of plants and insects are examined and used to construct a mathematic model. It is assumed that metabolic processes obey the following conditions: the same objects are participants in processes occurring in different parts of the metabolic network; some of the processes are autocatalytic; all processes touch spatially; and processes occurring without the participation of objects  $M_i$  occur at a rate determined by the rates of the individual enzyme reactions. Taking the periodicity of light action into account, under normal natural conditions the biological-clock model of insects is

$$\frac{dx}{dt} = k_1x - k_2xy - A_{11}x,$$

$$\frac{dy}{dt} = k_2xy - k_3y + k_4x,$$

where  $A_{11}$  is a square function such that  $A_{11} = 0$  when  $0 \leq t \leq T$  and  $A_{11} = \Phi$ , when  $T < t < T$ ;  $T$  is the period of external light;  $k$  are uniquely determined rate constants of the processes of the system. Orig. art. has: 8 formulas and 2 figures.

67.

AUTHOR: Gambaryan, P. P.

ORG: none

TITLE: Various gaits of mammals as possible models for the motion of lever machines

SOURCE: AN SSSR. Nauchnyy sovet po kompleksnoy probleme "Kibernetika". Voprosy bioniki (Problems of bionics) Moscow, Izd-vo "Nauka", 1967. 578-582

TOPIC TAGS: animal, motion mechanics, biologic model, vehicle engineering

ABSTRACT: A work of Sukhanov on the rhythms of the motion of extremities of quadrupeds (Byulleten' Moskovskogo Obshchestva Lyubiteley Prirody, 1965) is quoted, and his graphical representation of various gaits of these animals is discussed in an attempt to fit these motions into the mechanics of lever-driven vehicles. The asymmetrical gaits of mammals, grouped into ricochetting jumps and gallops, are believed to a result of the evolutionary adaptation to vertical jumps. Numerical values are given for the thrust and landing impact of these gaits, for Meriones tristrami, meridianus and persicus, Ochotona precei and Mustela nivalis. The characteristics of gaits of mammals which may be useful in designing and developing lever-driven track cars are listed as a speed of motion and a ratio between the transfer rates of the distal portions of extremities and the center of gravity, roughly proportional to the rhythm of work of extremities, i.e. to the reciprocal of the ratio between the time of support and the time of transfer of extremities. Orig. art. has: 1 figure and 1 table.

58.

AUTHOR: Grishin, V. G.

ORG: none

TITLE: A "visual" model of hearing perception

SOURCE: AN SSSR. Nauchnyy sovet po kompleksnoy probleme "Kibernetika". Voprosy bioniki (Problems of bionics) Moscow, Izd-vo "Nauka", 1967, 113-118

TOPIC TAGS: perception, human sense, bionics, coding, coding evaluation, image converter, image projection, pattern recognition

ABSTRACT: The hearing process was studied by formulating a two-dimensional model which parallels the operation of the eye's retina in observing a two-dimensional picture. Although the model is inexact, it is useful in studies of evaluating artificial sound codes for converting visual signals to audio images, so that "sights can be heard." The signals from the hair cells of the ear's cochlea, stimulated by sound, are transmitted to peripheral neuron systems where the audio image is formed on layers of two-dimensional sheets. One sheet coordinate axis is a function of frequency, the other is a time function. The audio signal is thus reduced to a dynamic frequency spectrum which is scanned to give the sound sense. Such phenomena as residual masking, inverse masking, and simultaneous masking by different frequencies are explained by this model. A device produced for recoding visual signals to audio signals provided unambiguous conversion, which the test subject was readily able to master. In a test where visual patterns of various quality were recoded to audio signals, the qualitative characteristics were maintained, confirming the validity of the model. Orig. art. has: 1 table and 2 figures.

69.

AUTHOR: Katinas, G. S.

ORG: none

TITLE: Characteristics of the biomechanical construction of pinnate muscles

SOURCE: AN SSSR. Nauchnyy sovet po kompleksnoy probleme "Kibernetika". Voprosy bioniki (Problems of bionics) Moscow, Izd-vo "Nauka", 1967, 570-572

TOPIC TAGS: bionics, cybernetics, biomechanics, musculoskeletal system, mathematic model, biologic model

ABSTRACT: The gain in load lifting and in rate of contraction of clusters that are at an angle to the direction of pull is substantiated. The relationship between the length of the clusters and the pinnate angle of the muscle is examined. It is found that the movement of the tendon is always greater than the contraction of the oblique cluster (see Fig. 1). In a muscle with parallel movement of the clusters, the contraction of the muscle is equal to the contraction of the clusters. To determine pinnateness, it is sufficient to measure the length of the largest and smallest clusters and the angle of deviation of the latter.

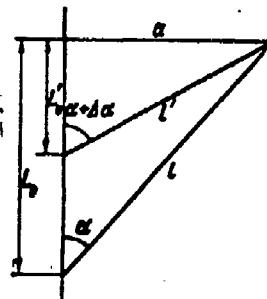


Fig. 1. Change in position of cluster in pinnate muscle with contraction

Orig. art. has: 8 formulas and 2 figures.

AUTHOR: Kazimikova, Ye. D.; Gulesha, Ye. A.

CRG: none

TITLE: The auto-oscillation nature of G-waves

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 57-58

TOPIC TAGS: EEG, biologic model, cerebral cortex, oscillation

ABSTRACT: The qualitative mechanism of oscillations of asymmetry of the alpha rhythm was investigated on the basis of auto-oscillation concepts. These concepts are used because of the characteristic difference of auto-oscillation from other oscillatory processes, i. e. independence of the amplitude and frequency of the established periodic condition from the initial excitation state of the system. An investigation was conducted to clarify the existence of an interrelationship between the auto-oscillations in different points of the cerebral cortex. A conclusion was drawn about the future development, if only for purposes of simulation, of dynamic models, distributed in space, of auto-oscillation systems of the "predator-victim" type (Artem'yeva, Meshalkin, 1965). Similar models were previously developed in a discrete (localized) variant (Walter) and proved to be extremely meaningful for application to certain biological problems (Khil'mi, 1966).

#### POSSIBILITY OF MODELING VISUAL AND AUDITORY SIGNALS BY DIRECT ELECTRICAL STIMULATION OF THE CEREBRAL CORTEX

Kogan, A. B., G. V. Goncharova, Ye. V. Kompaneyets, and V. G. Slyusar'. Mezhvuzovskaya nauchnaya konferentsiya po neyrokibernetike, 2d, Rostov-on-Don, 1965. Problemy neyrokibernetiki (Problems of neurocybernetics); materialy konferentsii, v. 2. Rostov-on-Don, Izd-vo Rostovskogo univ., 1966, 172-174.

AT7033547

The creation of electronic prostheses for the visual and auditory systems may be possible because these sensory functions are localized in the cerebral cortex and because they may be activated by direct electrical stimulation. The greatest difficulty lies in the fact that real perception represents the synthesis of many interacting signals in the projective field. The authors attempted to determine the extent to which electronic models of visual and auditory perception can match natural perception of the external world. One series of experiments was concerned with the auditory analyzer, and the other, with the

visual analyzer. For the latter, multiple-contact electrodes were attached in the visual analyzer region of cats. Stimuli were applied at various points, until a point was found at which stimulus caused the characteristic "glancing" reaction of turning the head toward the side opposite the stimulus. A conditioned food reflex was established in the animals; in some cats, the signal was the electrical stimulation of the cortex, and in others, it was the switching on of a lamp located in the "glance" target area. When these reflexes were firmly established, the stimuli were reversed; the cats with a reflex established for electrical stimulus were presented with the lamp, and those conditioned for the lamp were given cortical stimuli. It was found that in most cases, electrical stimulus at the appropriate point on the cortex of the auditory or visual analyzer could replace an adequate visual or auditory stimulus. This is evidence that the signal meaning of the light or sound stimulus and the electrical stimulus are identical. Thus, it appears possible to produce some effects of adequate afferentation by direct electrical stimulation of the analyzer systems. [EL]

72.

AUTHOR: Kornev, Yu. N.

ORG: none

TITLE: Certain analogies in the behavior of discrete automations and living organisms

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 70-71

TOPIC TAGS: finite automaton, reflex activity, behavior pattern

ABSTRACT: Features of the behavior of an abstract finite deterministic automaton are examined to determine the types of automaton behavior which can be compared with conditioned and unconditioned reflexes. The properties of an automaton necessary for development of conditioned reflexes of the first, second, and other orders are determined. The developed reflexes can be confused with change in the external environment, represented by a set of "work generators." It is noted that subautomats, defined in the sense of algebraic subsystems, determine the localizability of the automaton's reactions in a set of states. Aspects of automaton behavior similar to certain aspects of rational behavior (abstraction, discrimination, generalization, and others) and to disturbances of rational behavior are also examined.

73.

AUTHORS: Avinikidze, L. S.; Chavchiani, V. V.

ORG: none

TITLE: Some problems of modeling objects of molecular biology

SOURCE: AN SSSR. Nauchnyy sovet po kompleksnoy probleme "Kibernetika." Voprosy bioniki (Problems of bionics) Moscow, Izd-vo "Nauka," 1967, 305-311

TOPIC TAGS: bionics, mathematic model, biologic model, nucleotide, probability, biology, enzyme

ABSTRACT: Problems connected with the rate of multiplication of an object in a medium with nonoptimum parameters for the object are examined. A theory of "bioresonance" is proposed. When the composition of the nutrient medium differs greatly from that necessary for metabolism, malnutrition begins. This process intensifies with time, since the absorption of nutrients is a chain process. The chain process occurring in a living tissue is sharply resonant. The intensity of the chain process is a resonant function of the difference  $K - K_0$ , where  $K$  characterizes the nutrient composition and  $K_0$  the surrounding medium:

$$K = \frac{p_A + p_T}{p_G + p_C}; \quad K_0 = \frac{p_{A_0} + p_{T_0}}{p_{G_0} + p_{C_0}},$$

where  $p$  are the probability density functions for various nucleotides in the medium. A mathematic model is constructed for constants  $K$  and  $K_0$ , and variation in these parameters is discussed. A method for controlling chain multiplication of a single-celled organism is indicated, but adaptation and mutation are not considered. Orig. art. has: 21 formulas, 4 figures, and 1 table.

74.

AUTHORS: Labutin, V. K.; Molchanov, A. P.; Pavlovskiy, V. V.

ORG: none

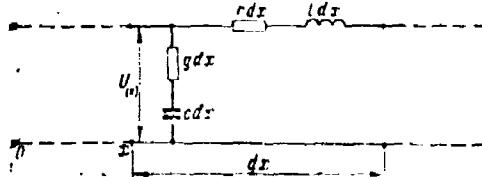
TITLE: A study of the characteristics of the electric model of the main membrane in the hearing organ as a "frequency-coordinate" converter

SOURCE: AN SSSR. Nauchnyy sovet po kompleksnoy probleme "Kibernetika". Voprosy bioniki (Problems of bionics) Moscow, Izd-vo "Nauka," 1967, 81-90

TOPIC TAGS: human sense, bionics, electric analog, mathematic model, model test, mathematic analysis

ABSTRACT: A mathematical analysis of an electric model simulating the ear's cochlea is developed, and the computed characteristics of the model circuit are compared with measured characteristics of an ear. The circuit shown in Fig. 1 provides the easiest analysis while preserving the qualitative nature of the phenomena involved.

Fig. 1. Equivalent circuit of a long line, simulating the main membrane



The differential equation of the voltage ( $U$ ) of the model is analyzed, with the circuit parameters assumed to have a weak exponential dependence on the line length ( $x$ ). For one part of the solution, a simplification is attained by considering some parameters to be constant and by neglecting certain terms associated with running waves. An expression for the transverse current ( $J_x$ ) as a function of  $x$  is then developed. A study of the modulus of  $J(x)$  vs  $x$  displays the amplitude-coordinate characteristic. The frequency for each point in the line, which will give a maximum  $J$ , is investigated as a function of  $x$ . The line transmission coefficient is analyzed, and an expression for the coordinate quality factor ( $Q_x$ ) is developed as a function of  $x$ . Finally, the equations are converted from the combined to the distributed parameters with exponential variation. The calculated characteristics so obtained agreed qualitatively with the measured values, and a more precise equation used with a computer gave analogous results. Orig. art. has: 7 figures and 46 formulas.

75.

AUTHOR: Letunov, Yu. P.

ORG: none

TITLE: On some engineering advantages of "biologic" (homogeneous) circuits

SOURCE: AN SSSR. Nauchnyy sovet po kompleksnoy probleme "Kibernetika". Voprosy bioniki (Problems of bionics) Moscow, Izd-vo "Nauka", 1967, 197-203

TOPIC TAGS: bionics, cybernetics, biologic model, memory element, reliability, communication network, switching circuit, switching theory, logic circuit

ABSTRACT: Some individual functional advantages of homogeneous circuits are studied without examining their technological merits. Formulas are given for calculating the speed of isotropic activity of periodic cell circuits, planar equicell circuits with isotropically packed cells (see Fig. 1), and tree circuits. The circuits have high response speed for slow-acting elements and can be used in creating communications networks, roads, and pipelines. Recommendations are made for minimizing expenditures, obtaining maximum reliability, and maintaining the overall control structure when the power of the network is increased. A reliable and high-speed diode-transformer memory for large volumes of information can be created.

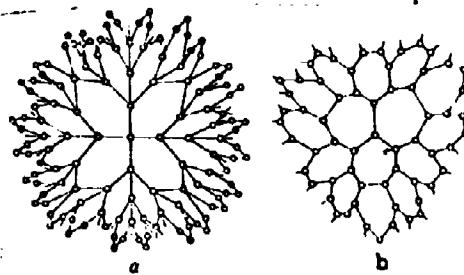


Fig. 1. Planar equicell circuits  
with isotropically packed cells:  
 $a-p = 4, r = 6; b-p = 3, r = 7$

Orig. art. has: 8 formulas and 6 figures.

76.

AUTHOR: Makeyev, A. V.

ORG: none

TITLE: The problem of sensory systems

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 88-89.

TOPIC TAGS: sensory motor area, reflex activity, biologic model, form recognition

ABSTRACT: In many branches of science and technology practical successes can be attained or stimulated only through solution of the problem of sensory biological systems. The complex nature of this problem and its connection with self-organization, thought, and consciousness are emphasized by various authors. The present work starts from a medical and biological concept of the reflex which stipulates as a necessary component a differentiated nervous system, and by abstracting from this concept a structural and functional plan (SFP) of the reflex, it expands the range of utilization of this concept so that it can be applied to the investigation of certain forms of biological movement from the subcellular to higher levels. This methodology reveals the dialectic nature of the sensory function of different biological objects. The understanding of life as a system of successive and complete biological levels of increasing complexity, and the application of the concept of the SFP of the reflex to their analysis or synthesis and to determine the relations and connections between them requires examination of the sensory systems of living organisms as hierarchical organizations. It is attempted to evaluate the current level of research in sensory systems by comparing biological and technological sensory models and systems for the recognition of forms.

77.

AUTHOR: Malakhov, A. N.; Teropov, L. A.

ORG: none

TITLE: Change in statistics of spontaneous activity of a receptor system under action of weak signals

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 90

TOPIC TAGS: biologic model, biopotential signal reception, cell physiology

ABSTRACT: A model is examined of the spontaneous activity of a receptor system in which random impulses are induced over the threshold fluctuations of the receptor potential. The distribution of intervals between the spontaneous impulses in the absence of a signal is of the Poisson type. A theoretical investigation was made of the law and parameters for distribution of intervals between impulses of spontaneous activity under action of weak signals of varied form on a receptor cell. The threshold sensitivity of this receptor system was evaluated for different signals.

78.

AUTHOR: Moshkov, B. S.; Fukshanskiy, L. Ya.; Yuzefovich, G. I.

ORG: Scientific Research Institute of Agrophysics (Agrofizicheskiy nauchno-issledovatel'skiy institut)

TITLE: The construction of a mathematical model of a "biological clock"

SOURCE: AN SSSR. Doklady, v. 167, no. 2, 1966, 440-443

TOPIC TAGS: mathematic model, biology, animal physiology, plant physiology, analog computer, computer application

ABSTRACT: Diurnal variations in the intensity of physiological processes have been established in all biological organisms having a more complex structure than bacteria. It is customary to assume that these variations ("physiological clocks" or "biological clocks") are developed in the process of evolution by a property which ensures the coordination of the time dependence of the various physiological processes among themselves and with the course of the periodic variations in the environmental conditions. An analysis of the properties of the "clocks" shows that their mechanism could be unified (with some variations) for all groups of living organisms, from plants to man. The present article proposes a mathematical model of a biological clock with analogs in live tissue. The model proposed, termed the first approximation model, has been investigated both analytically and on an electronic analog computer. It is shown that, provided certain conditions are satisfied, the model simulates all the basic properties of the biological clocks of higher plants. On the basis of the modeling considerations, the authors propose a series of experiments and predict their outcome. It is noted that the principle used may be employed to construct a mathematical model of biological clocks for animals. The proposed constructions may be used for a photoperiodism model. Orig. art. has: 5 formulas.  
[08]

79.

AUTHOR: Petrov, A. A.; Sragovich, V. G.; Sushkov, B. G.

ORG: Computer Center, Academy of Sciences SSSR (Vychislitel'nyy tsentr Akademii nauk SSSR)

TITLE: Possible mechanics governing the oculomotor apparatus

SOURCE: AN SSSR. Doklady, v. 166, no. 5, 1966, 1226-1229

TOPIC TAGS: physiologic model, optic model

ABSTRACT: The authors propose a theoretical model of the oculomotor apparatus, based on the work of D. P. Matyushkin on rabbits and cats. The authors propose a binary motor system for the human eye motor apparatus and suggest that control of the eye motor apparatus is a multilevel process, the lower level effecting realization of the eyeball movement but not synchronizing it. The authors propose that the motor complex is activated and coordinated by the action of a second level. A schematic for the model is given, followed by theoretical discussion of its applicability. The authors express their deep gratitude to V. S. Gurfinkel' for numerous discussions on physiology which gave impetus to the formulation of the problem and to A. L. Byzov, A. V. Lebedinskiy, D. P. Matyushkin, V. V. Tsetlin, and L. Vabrus for their discussion of the model. Orig. art. has; 1 : , re. [14]

80.

AUTHOR: Plotnikov, V. N.; Malakhov, N. A.

ORG: none

TITLE: Some problems of processing experimental results to obtain a mathematic model

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 115-116

TOPIC TAGS: mathematic model, digital computer, data processing, algorithm, least square method

ABSTRACT: The ultimate purpose of many investigations of the functional capabilities of the human brain is to obtain quantitative characteristics which reflect experimental results with sufficient precision. Approximation of results by the method of least squares is an appropriate mathematic treatment for this purpose. Much experimental material used in investigations, which are usually detailed, requires use of digital computers, but computational difficulties connected with the volume and specific character of the material often appear. Special algorithms for problem solution are necessary for overcoming these difficulties. The authors present operational algorithms for obtaining mathematic models on a digital computer which facilitate and accelerate processing of experimental data. The proposed algorithms ensure adequate models with sufficient accuracy. Cases of the applicability of these algorithms to concrete problems in processing experimental results were considered in finding heuristic programs of behavior.

81.

AUTHOR: Podkoryrov, A. L.

ORG: none

TITLE: Mathematic model for dorsal root reflex mechanisms

SOURCE: Vsesoyuznaya konferentsiya po neirokibernetike, 3d, Rostov-on-Don, 1967. Problemy neirokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 117

TOPIC TAGS: mathematic model, reflex activity, information processing, biopotential, electrophysiology

ABSTRACT: Presynaptic inhibition plays an important role among the regulating mechanisms for control and processing of information at the input of reflex apparatuses of the central nervous system. A mathematic model was made based on data from electrophysiological investigations about the time lapse of presynaptic inhibition. Depolarization of presynaptic endings was described by a linear nonuniform second order differential equation with constant coefficients. Change in the excitability of a presynaptic ending during its depolarization was described by a nonlinear nonuniform first order differential equation with variable coefficients. The expressions obtained show changes in the excitability of a presynaptic ending and distributions in time of moments of occurrence of a dorsal root reflex in relation to the degree of depolarization and to the parameters of the ending. The possible functional significance of the dorsal root reflex is considered.

3.

AUTH: Shevel V. I. A.

C.G: none

TITLE: Model of synchronization of initial afferent flow in the visual system

SOURCE: AN SSSR. Nauchnyy sovet po kompleksnoy probleme "Kibernetika". Voprosy bioniki (Problems of bionics). Moscow, Izd-vo "Nauka", 1967, 90-94

TOPIC TAGS: bionic model, visual signal, visual physiology, cerebral cortex

ABSTRACT: An attempt is made to utilize a continuous environment for modelling one of the most important operations of signal discrimination in the visual system: temporary peaking as it is transmitted from the lowest to the highest layer of the visual analyzer. Such peaking was observed in cats in investigating total electric responses at all levels of the visual system to light flashes of different intensities. These total evoked potentials reflect the integral behavior of large sets of elements of a given layer involved in a reaction, and for that reason can serve to a certain degree as a measure of the number of discharges and the degree of their synchronization. With a reduced light signal intensity, the total response of the second layer of the visual system (bipolars of the retina) disappeared earlier than the response of the elements of the third layer (output elements of the retina). The response of the fourth layer (neurons of the external geniculate body—relay on the route of the signal from the retina to the cortex) was preserved with lower light intensities; and, the total evoked potential of the highest analyzer level, the visual cortex, had the lowest threshold and disappeared last. These data indicate an increase in the number of responding elements at higher levels of the system and increased synchronization of their firing. The following aspects of a model of synchronization of initial afferent flow in the visual system are discussed: some properties of a multilayer system of excitable elements, receptive and projective fields and distribution of elements according to sensitivity to input signals, distribution of elements of different layers according to latency of response, and the formation of an integral analog reaction of elements of different layers. Grig. art. has: 2 figures.

3.

AUTHOR: Shklover, D. A.

ORG: none

TITLE: A mathematical model of color recognition

SOURCE: AN SSSR. Nauchnyy sovet po kompleksnoy probleme "Kibernetika". Voprosy bioniki (Problems of bionics) Moscow, Izd-vo "Nauka", 1967, 398-404

TOPIC TAGS: cybernetics, bionics, mathematic model, color, colorimeter, recognition process, radiation intensity, radiation receiver, adaptation

ABSTRACT: A mathematical model of color recognition is created to explain the mechanism of color vision. The light-distinguishing possibilities of a simple model consisting of three radiation receivers with strictly additive and linear characteristics and independent outputs are examined. The proposed model is based on the assumptions that the reactions of the radiation receivers are related nonlinearly to the intensity of the stimulating radiation and the spectral sensitivities; the chromaticity signals are formed by pairwise subtraction of the reactions of the three receivers; the signals characterizing color tone are formed by nonlinear transformation of the chromaticity signals and their further pairwise subtraction; the sensations of luminosity, saturation, and color tone are obtained by averaging; the contrast between colors is determined by adding the light contrast and the color contrast. Good correlation between the experimental and calculated data is obtained when using a logarithmic dependence of the reactions of the receivers upon intensity and the exponent. Orig. art. has: 8 formulas and 6 figures.

84.

AUTHOR: Stavitskiy, A. I.

ORG: none

TITLE: A discrete analog model of a sensory system for investigating information characteristics of the brain

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 142

TOPIC TAGS: biologic model, computer simulation, brain, human sense, analog computer system

ABSTRACT: The present investigation was based on determining the nature of interactions between conditionally selected regions of the brain. The connection in the present model between regions was realized with multiextremal nonlinear circuits, which are analogs whose topological structure (with a specific degree of approximation) was based on results of a preliminary biological experiment. The distinctive and most important feature of the model is its capability of carrying out systematic multichannel "interrogation" of a large number of nonlinear elements which have a sensory input including both discrete and continuous signals. The model can

compare the results of "interrogation" in different phase correlations and can perform complex controlled nonlinear transformations of the signals within a wide range of frequencies from fractions of a cycle to hundreds of kilocycles. Broad opportunities are suggested for synthesis of the most diverse analog circuits for model verification of different hypotheses during investigation of the brain's information structure. A general purpose functional polytron converter, which has a large number of inputs controlled by elements similar to neurons, is used as the basic element of the model.

85.

AUTHOR: Temnikov, F. Ye.

ORG: none

TITLE: Higher technological systems

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 146

TOPIC TAGS: bionics, automatic control theory, automaton

ABSTRACT: A concept of higher technological systems was introduced by analogy with higher biological organisms, thus expanding the range of systems concepts which have recently appeared. The author proposed classifications and definitions of systems, and examined the organization and informativeness of higher systems, defined as systems containing sections with higher functions and new information. Two types of organizations of higher systems with layered structures characterizing the different functional sections and different levels of behavior are proposed. A model of the formation of new information by special sections with multiple feedback between them and the external world was presented. Higher technological systems solve more complex problems than modern automata with simple, programmed, and reflex behavior. Such problems include: form and situation recognition; search for objects, phenomena and solutions functioning under unknown conditions; and, creative activity.

86.

AUTHOR: Ukhin, V. N.

ORG: none

TITLE: Some functional features of the mechanism for human binocular vision

SOURCE: Vsesoyuznaya konferentsiya po neirokibernetike, 3d, Rostov-on-Don, 1967. Problemy neirokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 153

TOPIC TAGS: visual perception, mathematic model

ABSTRACT: Perception of the external world by two eyes simultaneously presupposes the presence of a coordinating mechanism which provides analysis and fusion of monocular flows of sensory information. Some of its functional features ensure synthesis of the sensation of apparent motion in the central sections of the visual analyzer. The illusion of apparent motion appears during binocular stimulation of human eyes with two light flows close to modulation frequency. The presence of variable time delay between the two light stimuli is the basic condition necessary for appearance of the given effect. Under such conditions of stimulation the phenomenon of apparent motion becomes an indicator of perception processes occurring in the human visual centers. Synchronous microinterval analysis of the correlation of optic stimulation and states of the visible picture makes it possible to obtain a correlation of the input-output type, with subsequent interpretation on a mathematic model. A proposed model of nerve integration in the human visual system contains two interdependent neuron channels with units for logarithmization and integration and a unit which performs multiplication (first order correlation).

57.

AUTHOR: Uvarov, V. G.

ORG: none

TITLE: Mathematic simulation of the spatial properties of a receptive field

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrocybernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 152

TOPIC TAGS: visual perception, mathematic model, neuron

ABSTRACT: Any image falling on the retina forms a certain distribution of illumination on the photoreceptors. This can be given by the vector

$$\vec{E} = (l_1 l_2, \dots, l_N); l_i = l_i t,$$

where  $t$  is time and  $N$  is the number of photoreceptors in the retina. An impulsion frequency distribution appears in the cross section of the optic nerve which can be given by the vector

$$\vec{F} = (f_1 f_2, \dots, f_M); f_i = f_i t,$$

where  $M$  is the number of fibers in the optic nerve. The problem consisted of finding the relationship between these vectors. The retinal neurons were divided into two groups: 1) a layer of photoreceptors and horizontal cells; and, 2) structural-functional units connected with this layer. The signal at the output of each structural-functional unit corresponded to one component of a vector. The author examined a model consisting of one structural-functional unit and a layer of photoreceptors and horizontal cells to investigate the spatial characteristics of the process of signal origin at the output of one structural-functional unit in specific input situations. The results corresponded with known physiological facts. A structural-functional unit with a concentrically receptive field was also examined.

88.

AUTHOR: Vasilevskiy, N. N.

ORG: none

TITLE: Functional model of a skin analyzer

SOURCE: AN SSSR. Nauchnyy sovet po kompleksnoy probleme "Kibernetika". Voprosy bioniki (Problems of bionics) Moscow, Izd-vo "Nauka", 1967, 95-100

TOPIC TAGS: rabbit, biologic model, skin physiology, neuron, cerebral cortex, sensory motor area

ABSTRACT: The neuron organization of the cortex somatosensory area of a skin analyzer was investigated in experiments on rabbits. Peak activity of separate neurons in the first somatosensory area was recorded extracellularly with microelectrodes inserted into the animal's skull. Potentials from the microelectrode tip were fed into a cathodo repeater, and then into an amplifier. Since neuron activity was recorded for 1½-2 hrs the animals were anesthetized and switched to artificial respiration. The state of the animals was controlled by electrocorticogram, EMG and body temperature. Neuron activity was recorded on movie film and was continuously analyzed with special electric equipment. An analysis of the receptive fields of separate cortex neurons in various sections of the first somatosensory cortex area shows that basically there

are two types of neurons: type I and type II. Type I neurons are local, small in size and represent one modality (tactile, pressure and others); and, induced neuron reactions follow a short latent period (8—30 msec). Type II neurons are of an extensive nature, sometimes covering the entire skin surface, and often represent several modalities (tactile, pain, sound, light); and, induced neuron reactions follow a long latent period (30—80 msec). Skin receptors in the cortex somatosensory zone representing the head, neck and anterior extremities are often type I neurons; and, skin receptors in the zone representing the body and posterior extremities are generally type II neurons. Type I neurons primarily perform discriminatory functions and preserve the spatial structure of excitation in the neuron network. Type II neurons perform an integrative function; their reaction is plastic and readjusts according to signal content in the acting stimuli. Type II neurons participate in the transmitting functions of type I neurons, but probably their main function consists of switching the flow of afferent impulses to the effector elements. Extensive afferent connections provide the functional basis of plasticity for these neurons. Both neuron systems are connected with one another by direct connections and feedbacks (see Fig. 5). Orig. art. has: 5 figures.

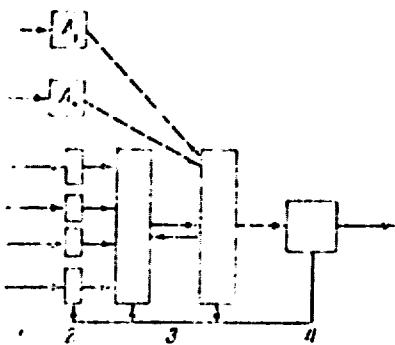


Fig. 5. Diagram of a skin analyzer neuron model.

- 1--afferent pathways;
- 2--neurons with local receptive fields forming the projective system of the analyzer cortex end;
- 3--neurons with widespread receptive fields comprising the associative apparatus of a higher section of the skin analyzer;
- 4--effector neurons.

$A_1$  and  $A_2$ --other analyzers whose afferent impulsion can converge on the associative neurons of each analyzer. The arrows show the transmission direction of impulses along direct connections and feedbacks.

89.

AUTHOR: Vepritskiy, A. S.; Zhak, S. V.

ORG: none

TITLE: Regulated structural model of the mammary gland reflex arc

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 21-22

TOPIC TAGS: biologic model, gland, reflex activity, muscle physiology, automatic control parameter

ABSTRACT: The physiological act of milk secretion from a mammary gland is considered a reflex reaction of the organism to a specific complex of external stimuli. The source of milk and its receiver form a biological system, whose biologically optimal state is self-regulation. A biophysical model of this biological system consists of: 1) the object; and, 2) the regulator with the controlling action (the stimulation function) and the regulated quantity (the amount of milk in a unit of time). The system of probability and its parameters change depending on external stimuli, the refractory period, etc. The controlled object consists of the motor apparatus (muscle tissues, changing milk capacities) and the reflex arc (the neuron network and the

humoral link). The physical relationships of the mammary gland are based primarily on Zaks' system (1952). Equations are formed for a structural model of the system, describing the basic links of the object and their relationships. This system of equations allows simulating the problem on a digital computer: assigning values for the parameters of biophysical relations, estimating the regulated quantity, and changing the controlling parameters to approximate the optimum. The ultimate purpose of the model is to establish optimal relations of the controlling parameters to the output characteristics of the system which determines the structure of the regulator. The randomness of model parameters can be realized by statistical simulation of the problem. Examples of computations of parameters of the regulator on a Minsk-12 computer are presented.

90.

AUTHOR: Volkov, N. G.; Lyspideskii, V. K.

ORG: Moscow Engineering and Physical Institute (Moskovskiy inzhenerno-fizicheskiy institut)

TITLE: Model with two photocells simulating human color vision and its anomalies

SOURCE: AN SSSR. Doklady, v. 168, no. 3, 1966, 687-690

TOPIC TAGS: vision, biocybernetics, photoelectric cell, electronic circuit

ABSTRACT: A model for simulating normal color vision defects including deuteranopia, protanopia, and tritanopia is described. The model (see Fig. 1) contains two photocells (K and P) each with positive and negative photoconductivity, and signals from the photocells are transmitted over channels I and II to input units 1, 2, and 3. Units 1 and 3 record steady-state current values and unit 2 records transient current values. The spectral characteristics of the fast and slow components produced by a square wave of light are different and independent, and thus the spectral characteristics of units 1, 2, and 3 are also independent. With

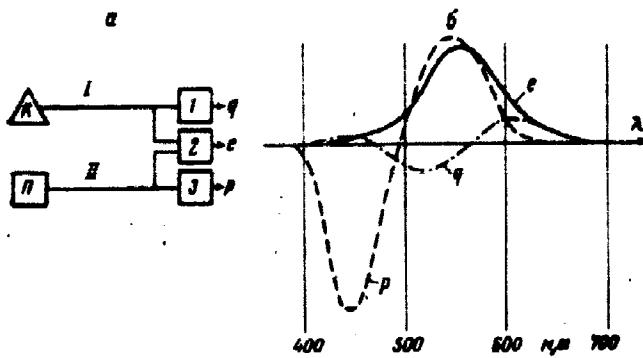


Figure 1

simultaneous operation of photocells K and P, the model simulates normal three-dimensional color vision. Photocells K and P correspond to the rods and cones of the retina and units 1, 2, and 3 correspond to the color receptors of the human eye. If only signals from the rods are transmitted over channel I and only signals from the cones are transmitted over channel II and the ratio between the number of rods and cones is 1:1, then the spectral characteristics of units 1, 2, and 3 will correspond to normal color vision. With the number of rods and cones affecting a single nerve fiber dependent on the position of the receptor field in relation to the center of the retina, deuteranopia appears with an increased visual angle and tritanopia appears with a decreased visual angle. Simulation of various color vision defects by rearranging the circuits and using the photocells and units in different combinations is described in detail. The authors thank I. V. Obreimov for discussing the work. Orig. art. has: 2 figures. [06]

91.

AUTHOR: Voronov, Yu. A.

ORG: none

TITLE: Biologic modelling and calibration of entities

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 27

TOPIC TAGS: biologic model, automatic control parameter, homeostasis

ABSTRACT: The problem of self-regulation of processes is related to questions of reliability and substitution. The functional similarity of the substituted and substituting element (cells, components, nerve centers, ganglia, etc.) is the basic principle of substitution. Two phenomena (processes) are functionally similar if the distinguishing features of one phenomenon coincide with the same features of the investigated phenomenon. Thus a nerve center and a parabiotic section of the nerve are functionally similar and can be used within specific limits as models of each other. When discrete entities entering into the phenomenon or process are similar to each other in all respects, such entities are calibrated. In other words, an entity is calibrated when it serves as an example of other entities in the process and can be substituted for any of them. Calibrated entities can be regarded as natural simulating of all kinds of similarity, even biological similarity. Atoms of a specific element, molecules of a specific substance, electrons from one and the same shells, erythrocytes, neural impulses, animal spermatozooids or ovicells, etc. can serve as examples of calibrated entities. Some lemmas and theorems for calibrated entities are: 1) any one calibrated entity can be substituted by another calibrated entity; 2) there are no standard entities among calibrated entities; and, 3) a certain deviation from similarity and a certain difference of calibrated entities is determined by the place of these entities among their "duplicates", which can number not only one or two, but hundreds and even many thousands. Calibrated entities are one of the adaptations directed toward maintaining homeostasis.

92.

AUTHOR: Yarovitskiy, N. V.

ORG: none

TITLE: On certain properties of a system transmitting images

SOURCE: AN SSSR. Nauchnyy sovet po kompleksnoy probleme "Kibernetika". Voprosy bioniki (Problems of bionics) Moscow, Izd-vo "Nauka", 1967, 59-64

TOPIC TAGS: optic image, image contrast, image degradation, image projection, optic resolution, visual signal, detection probability

ABSTRACT: The properties of a system transmitting an image were studied by using mathematical probability and by applying V. I. Glushkov's hypothesis of the extrapolation capacity to a specific system (1962. Vvedeniye v kibernetiku. Kiev, Izd-vo AN UkrSSR). This hypothesis places limitations on both the input signal and transmitting system. The probability of altering a signal by an amount larger than a given value must be limited to a certain small positive number. The circuit investigated here consisted of two sequences of elements,  $a_i$  and  $b_j$ , where each  $a_i$  has an input  $x$  and each  $b_j$  has an output  $z_j$ . The set  $X = \{x_i\}$  is the structural input, and, similarly,  $Z$  is the structural output. Each  $a_i$  can feed each  $b_j$ , and all the  $a_i$ 's are individually connected to all the  $b_j$ 's by separate channels  $y_{ij}$ . Input signals of different structure are fed to the system, and the output signal is studied by analyzing the probability functioning of the system. In this way the internal resolution of the system and its associated parameter are established, and, in turn, determine the probability that the system will detect (on a dark background) a light spot of a certain radius. A similar external resolution determines the probability that the system will detect (on a light background) any dark spot of a given radius. A combination of these two resolutions gives the probability of transmitting a certain pattern which can be used to construct models of the biologic processes. Orig. art. has: 2 figures and 18 formulas.

93.

AUTHOR: Yefimov, V. N.; Pysk, E. N.

ORG: Biophysics Laboratory RGU (Laboratoriya biofiziki RGU)

TITLE: Investigating biologic systems using theory of invariance methods

SOURCE: Mezhdunarodnaya nauchnaya konferentsiya po neirokibernetike, 2d, Rostov-on-Don, 1965. Problemy neirokibernetiki (Problems of neurocybernetics); materialy konferentsii, v. 2. Rostov-on-Don, Izd-vo Rostovskogo univ., 1966, 35-42

TOPIC TAGS: bionics, mathematic model, parameter

ABSTRACT: An important problem in modeling different properties of complex biologic systems is creating and analyzing systems with the property of invariance in relation to certain parameters of actions from the external environment. Such a system can be represented as:

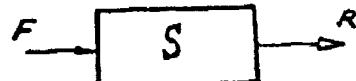


Fig. 1a. Diagram of a system with the property of invariance

a

where F is the input action and is not extraneous in the sense that it induces some changes in the system; and, R is the output reaction. A system is considered to have the property of invariance if it responds with the same reaction  $R_L$  to a group of different input actions  $F_L$ . A system of this type unites all incoming actions into classes according to essential characteristics which do not change with transition from one object to another within a given class. The problem in the present study is to find invariants with linear transformations connecting different actions within one class. For this purpose a method known as "moment invariants," based on the idea of the American researcher Ming Ku'eji Hu, is used and is shown as:

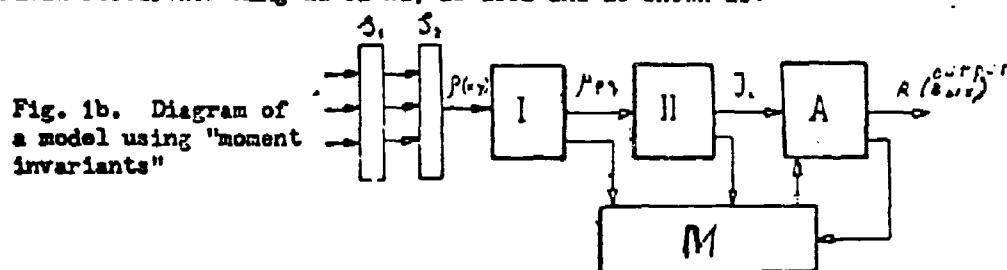


Fig. 1b. Diagram of a model using "moment invariants"

In this diagram  $S_1$  and  $S_2$  are the input units; I is a calculating unit of generalized characteristics ( $\mu_{pq}$ ) of input actions; II is a calculating unit of invariants ( $I_1$ ); M is a memory unit in which values of  $\mu_{pq}$ ,  $I_1$  and names of objects corresponding

to them are stored; A is an analysis unit evaluating the invariants and comparing them with data stored in the memory; and R (output) corresponds to the number of class actions. The input unit represents a field of sensitive elements with an arbitrarily attached system of coordinates (xy). Input action on the elements of a given receptor field can be described, without taking time into consideration, by a piecewise continuous and finite at any point function which is called a "density function"  $p(xy)$ . Given on the system of coordinates (xy). The value of  $p$  at any point of the field can assume different values within the limits zero to infinity. For solution of the problem, it is desirable that  $p$  have only two values:  $p_{\min}$  and  $p_{\max}$ . To achieve this, a second layer of the receptor field  $S_2$  is introduced which has the same number of elements as the first layer  $S_1$ . Elements of  $S_2$  receive actions from the field cell outputs of  $S_1$ . The state of the cells of field  $S_2$  is described by the function  $p(xy)$  where  $p$  can assume only the two mentioned values:  $p_{\min} = 0$  and  $p_{\max} = 1$ . The action of the density function  $p(xy)$  is fed into the input of unit I which calculates the moments from this function according to a formula. Formulas are presented which make it possible to express any of the moments from the transformed input function  $p^1(xy)$  by using moments from the initial function and transformation coefficients. With formulas found for unit II, invariants  $I_1$ ,  $I_2$  and  $I_3$  are calculated; and, on the basis of these invariants, identification of different actions is made. Since these invariants can be preserved only with linear transformations, the presence of some deviations from linearity or the presence of noise can lead to significant changes of invariant values and consequently to erroneous reactions. Orig. art. has: 7 formulas.

94.

AUTHOR: none

ORG: none

TITLE: A mathematic model of the oculomotor apparatus

SOURCE: VDNKh SSR. Informatsionnyy byulleten', no. 2, 1968, 39-40

TOPIC TAGS: mathematic model, visual physiology, reflex activity, neuron, muscle stimulation, nerve fiber

ABSTRACT: D. P. Matyushkin in his research on animals uncovered the duality of the oculomotor apparatus in the form of two specialized motor systems. One is the tonic system responsible for slow eye movements, and the other is the phase system responsible for rapid eye movements. Each system has its own typical muscular and nerve fibers differing in structure and physiological properties. These systems are also found in man. Most eye movements are the result of complex interaction of the tonic and phase systems. Movement of the eyes is performed by a motor complex consisting of external eye muscles (six in each eye) and three pairs of innervating craniocerebral nerves with nuclei in the brain stem. The motor complex is controlled by a complex representing a multilevel system whose units are activated by visual, auditory, vestibular, and other stimuli. Interaction of all levels of the hierarchical

control system provides a variety of eye movements. Coordination of position and movement of eyes is accomplished by three reflexes: stretching, nystagmic, and convergent. With one eye moving sideways and the activity of the contracting muscle weakened, the stretching reflex excites its antagonist. With simultaneous movement of the eyes to the sides, the nystagmic reflex excites the muscle antagonists which synchronously return the eyes to their initial position. The convergent reflex brings both eyes together if they are far apart or separates them if the visual axes are too close. Each of the reflexes is realized by a neuron network. On the basis of these principles a model of the oculomotor apparatus is proposed. Free movements of the eye or tracking of a moving object are ensured by the control signals of the highest levels of the oculomotor apparatus, which change the state of the neuron networks by exciting or inhibiting them. In the absence of any control signals, the structures of the first level of the control complex stabilize the eyes in a neutral position. The examined principles of oculomotor apparatus control make it possible to explain various eye movements including adaptation to darkness, compensatory movements, and vestibular nystagmus. A mathematical model of the oculomotor apparatus is on display at the Physics Pavilion of the Exhibition of Achievements of the National Economy of the USSR. Orig. art. has: 1 figure. [WA-10-68-8] [06]

## SECTION. B. NEURONS IN BIONICS AND BIOCYBERNETICS

### Sub-Section 1. The Study of Neurons, Neuron Organization, and and Neuron Networks.

95.

AUTHOR: Antomonov, Yu. G.

ORG: none

TITLE: Optimality criteria for organization of biosystems

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 7

TOPIC TAGS: nervous system, nerve cell, learning process

ABSTRACT: The nervous system of living organisms was formed in the process of evolution. Optimality criteria of phylogeny are reflected in the special features of the structural organization of analyzer systems. The functional special features of parts of the nervous system are acquired in the process of ontogeny, as the result of learning. An attempt is made in the report, based on experimental and theoretical data, to discover criteria for changing the organization level of different parts of the nervous system. Evaluations of structural and functional organization are presented, and possible criteria for optimal work of different neural formations are considered. Theoretical and experimental results are presented confirming the optimality of work of the nerve cell. Criteria for evaluation of the organization level are employed for comparative evaluation of visual and auditory analyzers. Experimental results are examined for teaching man the solutions to problems of varied complexity, and one possible interpretation of optimality of the learning process is given.

96.

AUTHOR: Berezovskiy, A. M.; Karpenko, L. D.; Chorayan, O. G.

ORG: none

TITLE: Some regularities of bundle impulse activity

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy noyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 12

TOPIC TAGS: nerve cell, neuron

ABSTRACT: Much neurophysiological data of recent years attest to the presence of two basic types of background impulsion of nerve cells, unit and bundle, reflecting the functional features of the nerve cells. Apparently each of these types in turn combines several particular types of background impulsion, whose differences are determined by structural features and by the location of cellular elements in the neuron networks. Statistical characteristics of impulse activity of the "respiratory" neurons of the medulla oblongata of the frog, a comparatively simply organized form of bundle impulse activity, were studied. Change of interimpulse intervals in the bundle according to a parabolic dependence was observed. A definite connection between the duration of the bundle, the interimpulse interval in the bundle, and the duration of the interbundle interval was also found. Emphasis is placed on the interconnection of work between the two generators, ensuring a distribution of intervals between bundles and between interimpulse intervals inside the bundle. A number of hypotheses are expressed on the nature of formation of various phases of neuron reactions, and on the role of tracking mechanisms in neuron activity. The significance of antagonistic reciprocal relationships in the system of cells examined in ensuring rhythmicity of impulsion is discussed.

97.

AUTHOR: Bulygin, I. A. (Academician AN BSSR); Sokolovskiy, O. E.

ORG: Institute of Physiology AN BSSR (Institut fiziologii AN BSSR)

TITLE: Features of electric reactions of motor neurons of a sympathetic ganglion to centrifugal and centripetal influences

SOURCE: AN BSSR. Doklady, v. 11, no. 12, 1967, 1122-1125

TOPIC TAGS: cat, neuron, sympathetic nervous system, adrenal gland, biopotential

ABSTRACT: Literature data indicate that centrifugal influences are related primarily to the stimulation of cholinergic sympathetic preganglionic neurons and to a lesser degree of the adrenergic preganglionic neurons, and that centripetal influences are transmitted primarily or exclusively by the adrenergic sympathetic afferent fibers. The authors showed in earlier experiments on the postmesenteric sympathetic ganglion (PSG) of dogs and cats that the threshold of centrifugal influences on the smooth muscles of the urinary bladder is considerably lower than the threshold of centripetal influences on this organ; and, also that the motor reaction as well as the ganglionic neuron shifts of noradrenalin and adrenalin in the first case are more clearly expressed than in the second case. To test these conclusions, electric reactions of the motor neurons of the PSG were recorded directly using leads from the central end of one of the hypogastric nerves; the reactions were induced by electric stimulation of the peripheral end of one of the preganglionic neuron stems (centrifugal influences) or the central end of another hypogastric nerve (centripetal influences). The experiments were staged on cats under ether or urethane and stimulation was produced by single square pulses of 1 msec duration and an amplitude of 0.1 to 5 v. Findings show that the thresholds of the electric reactions of the hypogastric nerve with stimulation of the preganglionic neuron stem is much lower than with stimulation of the other hypogastric nerve; the figures for the first are 0.1 to 0.25 v and for the second are 1 to 4 v. In both cases the thresholds appear in 25-30 msec (see Fig. 1). In additional experiments the effects of ganglionic blocking agents such as pentamine on electric reactions, and also of adrenolytics, were studied. The study shows that the electric reactions induced by stimulation of the preganglionic neurons (centrifugal influences) are characterized by a much lower threshold and stronger reactions to supramaximal stimulation than stimulation of the visceral afferent sympathetic fibers (centripetal influences). With stimulation of the preganglionic neuron stems, both the cholinergic and adrenergic fibers are excited; but, with stimulation of the visceral afferent sympathetic fibers, mostly the adrenergic fibers are excited, and they secrete a lesser quantity of noradrenalin into the ganglionic neuron synapses than in the first case. Orig. art. has: 2 figures.

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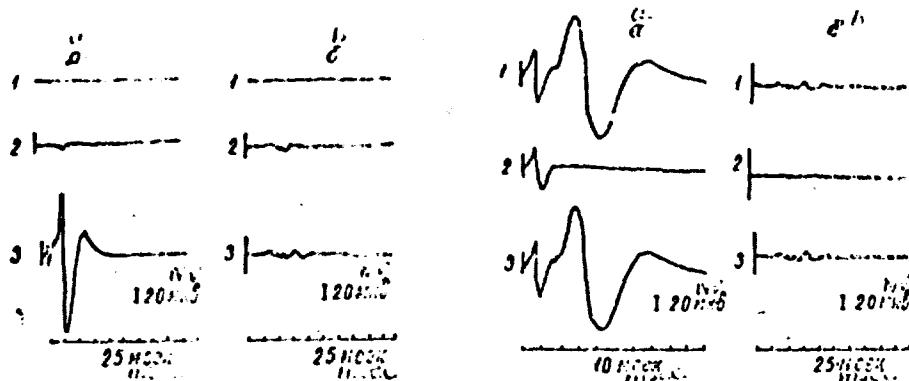


Fig. 1. Electric reaction of the central end of a hypogastric nerve of a cat to single stimulation of: a) the preganglionic neuron stem (PGN); and, b) central end of another hypogastric nerve.  
1--background recording; 2--threshold reaction (threshold current strength for a - 0.25 v and for b - 1.5 v); 3--supramaximal stimulation (current strength for a - 2 v and for b - 5 v). Vertical line at the 1.0 sec of the electrogram is the moment at which the single electric shock was applied.

98.

AUTHOR: Chumachenko, A. A.; Yefimov, V. N.

ORG: none

TITLE: Functional organization of certain neuron ensembles

SOURCE: Vsesoyuznaya konferentsiya po neirokibernetike, 3d, Rostov-on-Don, 1967. Problemy neirokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 164

TOPIC TAGS: rabbit, cat, neuron, reflex activity

ABSTRACT: Experimental data obtained by extracellular recording of nerve cell impulse activity under different effects leading to change in neuron function were examined. In one series of tests on rabbits, sections of the medulla oblongata corresponding to the bulbar respiratory center were investigated by application of direct electric stimulation with direct and alternating current. In another series on cats, changes in the functioning of cortical neurons in the process of developing a self-stimulation reflex of the subcortical formations were studied.

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99.

AUTHOR: Fam, Khyu Khoyan

ORG: none

TITLE: A probability mechanism for convergence of different afferent impulses on Purkinje's cells

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 153-154

TOPIC TAGS: nerve, cell, probability, cell physiology

ABSTRACT: Explanation of the convergence mechanism of different afferent impulses on the same cell can play an important role in study of the probability nature of the neuron organization of different sections of the brain (Kogan, 1952-1966). The convergence phenomenon was studied according to indices of impulse activity of two or more simultaneously recorded Purkinje's cells during successive action of stimuli with different modalities. It was established that each cell can react with a certain probability to stimulation arriving by various routes. The characteristics of the reaction vary greatly depending on sequence of stimulation, intervals between stimulation, and strength of the stimulating current. Complex forms of interneuron connections were discovered during simultaneous investigation of the phenomenon of convergence of afferent impulses in several cerebellar neurons. Stable reactions of cerebellar neurons to stimulation with one modality became variable under conditions of convergence of stimuli of other modalities. It is supposed that the convergence mechanism of different afferent impulses on Purkinje's cells has a probability nature. Under the influence of convergence the randomness and variability of the reaction of these cells become more expressed, reflecting to a specific degree the complex random properties of the external environment.

**NOT REPRODUCIBLE**

11.

AUTH: Karapetyan, V. V.; Sarkisyan, S. S.; Pogosyan, R. I.

CRG: neu

TITLE: Some principles of regulation of neuron activity of the red nucleus

SCITEC: Vsesoyuznaya konferentsiya po neirokibernetike, 3d, Rostov-on-Don, 1967. Problemy neirokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 154

TOPIC TAGS: cat, neuron, cell physiology, brain, cerebral cortex, biopotential

ABSTRACT: Features of the background and induced activity of neurons of the red nucleus were studied in experiments on cats with glass intracellular microelectrodes. These neurons were identified by antidromic stimulation of the rubrospinal tract. The distribution of electric fields in a cross section of the midbrain was investigated with antidromic activation of neurons of the red nucleus. It was demonstrated that the source of negativeness is the zone of maximal activation. This source is 2 mm in diameter and is located 7.5-10.0 mm from the surface of the anterior tubercles of the lamina quadrigemina. This zone of activity coincides exactly with the morphological position of the gigantocellular part of the red nucleus. It was established that stimulation of the contralateral intermediate nucleus of the cerebellum leads to monosynaptic excitation of neurons of the red nucleus. Stimulation of the sensorimotor region of the ipsilateral hemisphere of the cerebral cortex also exerts a monosynaptic effect on these neurons. Differences were discovered in the monosynaptic connections of cellular elements of the red nucleus. A number of experiments demonstrated the possibility of antidromic activation of neurons of the red nucleus upon stimulation of the contralateral intermediate nucleus of the cerebellum.

AUTHOR: Pol'dman, G. L.

**NOT REPRODUCIBLE**

C.R.G.: none

TITLE: Neuron organization of the cerebral cortex during sleep inhibition

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 155

TOPIC TAGS: cat, rabbit, cerebral cortex, neuron, sleep, EEG

ABSTRACT: The impulse activity of one or several neurons in the cortex is simultaneously with focal and surface of cortex. Experiments were conducted on unrestrained kittens and rabbits during development of natural or induced sleep by low frequency stimulation of the thalamus or by administration of hexenal. Reorganization of the neurons occurs during development of sleep. Discharges decrease or increase and continuous discharges are replaced by grouped ones. During light sleep, impulse activity of a mixed (continuous-group) nature is recorded. When slow waves appear in the EEG a clearer grouping of discharges is recorded. Greater sleep inhibition leads to a more strongly expressed relationship of impulse discharges to slow waves. The sequence of impulse discharges of the background activity of cortical neurons during sleep is determined by the results of probability influences of a great number of other neurons and by the effect of general integrating mechanisms. The importance of each of these effects can be different every time and depends on many factors, one of which is depth of sleep.

102.

AUTHOR: Florov, A. E. Shugurov, C. A.

C.R.G.: none

TITLE: Functional significance and mechanisms of origin of the dorsal reflex in control processes at the reflex arc input

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 157

TOPIC TAGS: reflex activity, neuron, spinal cord, biopotential

ABSTRACT: The results of observations during the influence of nonsegmental intercalary neurons in the origin of the dorsal reflex. Repetitive discharges of these neurons caused by mutual excitation are of particular significance. A conclusion was formed on the basis of new facts about the role of axo-axon connections of nonsegmental intercalary neurons (the fourth layer according to Roksed, 1954) in generating antidromic discharges in group A cutaneous fibers. The significance of the dorsal reflex in the control processes at the input of the reflex arc was considered.

103.

AUTHOR: Galyas, Yu. A.; Florov, A. K.

ORG: none

TITLE: System for statistical evaluation of amplitude changes in slow processes in the central nervous system

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrocybernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 27-28

TOPIC TAGS: central nervous system, biopotential, automatic control system, memory element, statistic process

ABSTRACT: Slow potentials appearing under conditions of natural and artificial stimulation are an important characteristic of integrated processes in the central nervous system. The problem of constructing a system for automatic statistical processing of slow bielectric processes in the central nervous system is examined and possible methods for obtaining statistical estimates are considered. A method is proposed for automatically obtaining statistical estimates with recording of frequently repeated slow processes. An electronic automatic system which contains units for memory conversion and for control and treatment of the processes investigated is discussed.

104.

AUTHOR: Genkin, A. A.; Vasilevskiy, N. N.

ORG: none

TITLE: Level of asymmetry of EEG phase durations in different layers of the cortex and the impulse activity of nerve cells

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrocybernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967. 32

TOPIC TAGS: rabbit, EEG, electrocorticogram, neuron, cerebral cortex, phase analysis

ABSTRACT: Regularities in the dynamics of impulse activity of nerve cells cannot be understood without analyzing the time relationships between them and the slow and gradual electric activities of the brain. The authors studied the relationship of peak activity and asymmetry of electrocorticogram phase durations, recorded directly near the neuron and from the surface of the cortex. The investigation was conducted on twenty-five neurons of the sensory motor cortex of the rabbit, recorded extracellularly during spontaneous discharges and at time of sensory stimulation. Values of asymmetry in successive seconds have slow oscillations comparable to those observed in man. These oscillations in the cortex and on the surface are most often

opposite in phase for spontaneous recordings; but under stimulation the character of these oscillations and the level of asymmetry clearly changed. The level of asymmetry for both leads increased and the dispersion near the mean level changed. Phase opposition could change to cophasing. Decrease in discharge frequencies during stimulation was generally observed with considerable increase of dispersion near the mean level of asymmetry or with stable phase opposition of the surface and intracortical electrocorticograms. A hypothesis is advanced on the origin of the slow electric processes of the brain and their role in the organization of neuron activity.

105.

AUTHOR: Glushkov, N. N.; Zagoruyko, N. G.; L'vov, V. A.; Storozhuk, V. M.

ORG: none

TITLE: Classification of neurons of the somatosensory cortex according to results of electronic computer processing

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 33

TOPIC TAGS: neuron, electronic data processing, cerebral cortex, magnetic recorder

ABSTRACT: Processing of 150 neurons was performed on a Dnepr electronic computer under six different programs to verify a hypothesis on the probability-statistical organization of intracortical relationships. The initial information was input from a Yauza-10 magnetic recorder. The output was graphs on a EPP-09 automatic recorder or on an electron ray tube with subsequent photographing. A conclusion was drawn from the statistical characteristics obtained on the nature of relationships between neurons in the primary somatosensory cortex.

106.

AUTHOR: Kalandarishvili, T. V.; Gachechiladze, R. G.

ORG: none

TITLE: Some mechanisms for the formation of synapses

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 58

TOPIC TAGS: neuron, electron microscope

ABSTRACT: The authors investigated the formation of collaterals in different sections of the central nervous system under conditions close to normal. Attention was devoted to the role of different mediums (culture mediums, fixatives, dyes) in the formation of figures and their movement. Formations of collaterals and fluid crystals of different origins are compared and evaluated. The new formations are evaluated using data obtained by optical, ultraviolet, polarization and electron microscopes.

107.

AUTHOR: Karpenko, L. D.; Chorayan, O. G.

ORG: none

TITLE: Functional organization of central respiratory neurons in amphibians

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 59-60

TOPIC TAGS: frog, neuron, biopotential, probability

ABSTRACT: The system of respiratory neurons is generally considered to be a historically formed structure of neurons and interneuron connections which accomplishes rhythmic change of inspiration and expiration. For understanding the self-regulation of this respiratory function, it is useful to investigate the neuron organization of a respiratory system in lower vertebrates which has a weakly developed reticular formation (Sepp, 1959). The present work is a microelectrode investigation of neurons of the frog medulla oblongata. Systems of inspiratory and expiratory neurons were distinguished, and cells were discovered in these systems with different impulsations (gradual growth in impulsion frequency, more or less uniform sequence of action potentials, etc.). Intracentral and peripheral regulation of the respiratory rhythm in the impulse activity of these nerve cells are considered. Factors which determine the probability nature of interneuron relationships of synergic (inspiratory or expiratory) or antagonistic cells are also considered.

108.

AUTHOR: Karpukhina, A. M.

ORG: none

TITLE: Functional and structural neuron organization of a respiratory center

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 60

TOPIC TAGS: cat, neuron, brain, information processing, biopotential, biologic respiration

ABSTRACT: Electrophysiological investigation of the respiratory center of the cat medulla oblongata with glass microelectrodes demonstrated that there are continuously active inspiratory, expiratory, and boundary neurons in the lateral section of the reticular formation which change frequency according to phases of the respiratory cycle. It was established that the respiratory center of the medulla oblongata contains respiratory neurons with all types of activity located among a general diffuse mass of reticular cells as compact interconnected groupings. Each grouping consists of respiratory neurons with all types of activity. The cellular groupings of respiratory neurons are considered as a substrate for integrated information

processing in a functional system of respiration. Interneuron interrelations were analyzed by the logic-probability method (Ponomareva, 1966; Karpukhina and Ponomar 1967), which makes it possible to assess both the nature and quantitative weight of the connection. The data indicate that the respiratory system is a typical functional system, and the various types of respiratory neurons, identified according to their electrophysiological characteristics and the natures of their interrelations, correspond to the logic of processes for formation of stages of a functional system.

109.

AUTHOR: Khedolidze, M. A.; Dumbadze, S. I.; Apridonidze, V. G.; Sokolova, N. A.; Gagua, Kh. G.; Zhorzholiani, B. T.

ORG: none

TITLE: Transformation mechanism of electric and magnetic fields in the nervous system

SOURCE: Vsesoyuznaya konferentsiya po neirokibernetike, 3d, Rostov-on-Don, 1967. Problemy neirokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 158

TOPIC TAGS: electromagnetic biologic effect, audition, brain, neuron

ABSTRACT: Experimental investigations confirmed literature data concerning the radiosound effect, i. e. the direct perception in the auditory region of animals and man of local impulse electromagnetic fields in frequencies from 200-1000 mc with intensities lower than  $10 \text{ mw/cm}^2$ . The authors analyzed experimental data on conducting circuits in the system of the brain, the semiconductor properties of synaptic contacts of neurons, and possible processes and electrokinetic transposition in the synapses.

110.

AUTHOR: Kogan, A. B.

ORG: none

TITLE: Organization of nerve cells in neuron ensembles

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 64-65

TOPIC TAGS: neuron, biopotential, probability

ABSTRACT: Accumulating morphological and functional data on the organization of central nerve mechanisms from individual nerve cells make it increasingly apparent that even the most simple nerve center is formed not from a uniform mass of homogeneous cells but from combinations of their heterogeneous groups. The history of the development of the neuron ensembles concept is reviewed and an attempt is made to describe a neuron ensemble as an internally integrated dynamic system of high reliability made of interchangeable neurons connected by a continuous circulation of impulses. Electrophysiological indices of impulse activity recorded simultaneously from several nerve cells and compared with morphologic and metabolic characteristics disclose certain general features of ensemble organization, as well as specific features of nerve cell ensembles forming nerve mechanisms of a different type of structure. Hypotheses are expressed about certain structural differences and functional features of ensembles of the diffuse, nodular, and tubular nervous systems, and also about specific properties of the probability-statistic organization of neuron ensembles of higher sections of the brain.

III.

AUTHOR: Kogan, A. B. (Rostov University); Popov, I. V. (Rostov University)

ORG: none

TITLE: Transformation of a stationary Poisson flow of impulses in a nerve cell synapse

SOURCE: Mezhvuzovskaya nauchnaya konferentsiya po neyrokibernetike, 2d, Rostov-on-Don, 1965. Problemy neyrokibernetiki (Problems of neurocybernetics); materialy konferentsii, v. 2, Rostov-on-Don. Izd-vo Rostovskogo univ., 1965, 42-45

TOPIC TAGS: neuron, biopotential, Poisson coefficient, probability distribution

ABSTRACT: The action of a Poisson flow of impulses on one synapse for the case of background activity is analyzed in the present study. According to the mediator theory of transmission of excitation through a synapse, each impulse arriving along the axon to the synapse is accompanied by secretion of a certain number of molecules of a chemical substance, the mediator, into the synaptic fissure. Generally, the amount is not constant. It is assumed that bundles of the mediator molecules represent uniformly distributed independent positive random values  $x$  with a distribution function  $H(x)$ , and that the decomposition of the mediator is constant in time. Also, it is assumed that a local Postsynaptic potential (LPSP) appears in response to each input impulse and the amplitude of the LPSP is proportional to mediator concentration in a synaptic fissure. After determining distribution function for the mediator concentration, it can be used to find the amplitude probability distributions of LPSP. Formulas are worked out showing that the distribution function of the amplitude probabilities of LPSP originating in the synapse under the action of a stationary Poisson flow of impulses is determined by the similarity of characteristic functions as described by L. Tackacs (1962), P. Levy (1937) and G. Kramer (194?). It is demonstrated that the distribution of LPSP in the synapse is no longer of the Poisson type and that the synapse itself realizes a probability relation between the elements of the central nervous system. Orig. art. has: 6 formulas.

112.

AUTHOR: Kogan, A. B.; Vladimirschiy, B. M.

ORG: none

TITLE: Nature of background activity of neurons of the higher sections of the brain

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 65

TOPIC TAGS: neuron, cerebral cortex, probability

ABSTRACT: Proceeding from a hypothesis on the probability-statistic organization of the functional systems of higher sections of the brain (Kogan, 1952, 1955), it is supposed that neuron background activity reflects the activity of a mechanism which provides a sufficiently high level of nerve center efficiency. The relation of the number of neurons displaying background activity to the total number of neurons was evaluated from the viewpoint of theoretical investigations of the dynamic properties of generalized transformations in spaces with arbitrarily large dimensions (Goncharov, 1944; Rubin, Sitgreaves, 1954). It was demonstrated that with greater complexity of the system (the total number of elements becoming quite large), the probability of an arbitrary trajectory changing into a cyclic one approaches unity. If the analyzer zones of the cerebral cortex are considered as very complex dynamic systems, this means they inevitably contain undamped oscillation, and these appear as background activity of the neurons.

113.

AUTHOR: Kogan, A. B. Zaguskina, S. L.; Vladimirschiy, B. M.

ORG: none

TITLE: Mathematic analysis of the spatial organization of structural chemical processes in the neuron body

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 66

TOPIC TAGS: crayfish, neuron, muscle stimulation, RNA, enzyme, mathematic analysis

ABSTRACT: The present work attempts to develop mathematic approaches to the analysis of probability regularities in the spatial interrelation of intracellular microstructures. Single nerve cells of crayfish tension receptors were investigated with a complex electrophysiological-cytochemical method. Regularities in the distribution of RNA structures (tigroid) and in cytochrome oxidase activity (mitochondria) in the neuron under various working conditions were established by analysis of cytophotometric curves. Examination of these curves as time series made it possible to form hypotheses relative to the mechanisms which determine the spatial interrelations of intracellular microstructures. This approach has a number of

advantages over the utilization of electrophysiological indices alone: 1) simultaneous calculation of the behavior of a very large number of neuron microstructures or microsections is possible; 2) use of different cytochemical indices for specific working conditions of the neuron make it possible to study different aspects of their functional organization; and, 3) input and output information can be precisely located and taken into account. It can be expected that laws for the functional organization of the neuron have many features in common with the functional organization of the neuron ensembles and the brain as whole.

114.

AUTHOR: Kondrat'yeva, I. N.; El'kina, G. A.

ORG: none

TITLE: Investigation of stimulating and inhibiting periods in the reactions of neurons of an isolated cortical stria

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 69

TOPIC TAGS: neuron, biopotential, cerebral cortex, neurophysiology

ABSTRACT: Impulse activity was recorded for 150 individual elements from neurally isolated striae of the visual and sensorimotor regions of the cortex of unanesthetized rabbits. In contrast to the intact cortex, the spontaneous impulse activity of neurons of the stria often had a rhythmic and group character. The same types of neuron reactions which appeared in the intact cortex in response to afferent stimuli were discovered in response to stimulation of deep layers of the cortex. Excitation began in some neurons 1-60 msec after the stimulus and in others the activation phase was noted at later periods higher than 400 msec. Presence in an isolated cortical stria of neurons with late activation reactions indicates the gradual propagation of excitation along the cortex in a chain like manner (Livanov, 1965). In the first few hours after isolation the neuron reactions consisted as a rule of a single activation phase. Five to six hours after isolation the neuron reactions often but not always had a phase character in which excitation was replaced by inhibition. During the inhibited interval there was no reaction to the test stimulus, and this reaction was restored only during the second activation phase. The inhibited interval in the neurons of an isolated stria surpassed in duration the interval observed for afferent stimuli in an intact cortex (300-400 msec instead of 100-200). Thus, new proof was obtained that the inhibited interval in the impulse activity of neurons and the period of subnormality in the restoration cycle is caused by an active process and not by refractivity, since they can be read in the first hours after isolation of the cortical stria. Restoration of the inhibited interval and the period of subnormality indicates that elements inducing inhibiting reactions are probably present in the cortex itself.

115.

AUTHOR: Kopylov, A. G.

ORG: none

TITLE: Principles of the rhythmic activity of neurons

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 70

TOPIC TAGS: animal, neuron, biopotential, information processing, excited state

ABSTRACT: Transmission of information in the nervous system is accomplished according to the plan: stimulus → local specific change of the membrane potential of the neuron → excitation potentials. The number and frequency of the excitation potentials carry information about previous events. The present work was done to clarify the causes leading to change in the excitation potentials. Experiments were conducted on non-adapting (pacemaker) and adapting neurons of gastropod mollusks, while recording intracellular potentials, under direct intracellular stimulation by electric stimuli of various forms. With very slow change in intracellular polarization in a nonadapting neuron, curtailment and cessation of the excitation potentials can be induced by changing the membrane potentials from point B both towards increase and towards reduction. For correct deciphering of the information found in the excitation potential changes, it is important to know the region of the membrane potentials in which these changes take place. "Switching on" and "switching off" effects, expressed in change of the frequency and number of excitation potentials, are added to the Y-shaped relationship under the action of steeply rising and falling current shocks. The degree and duration of the "switching on" and "switching off" effects depend on the gradient and duration of the stimuli. In addition, changes in the frequency and number of the excitation potentials in adapting neurons depend on the speed of adaptation of the neuron to the stimulation.

116.

AUTHOR: Kotova, A. B.

ORG: none

TITLE: The ion mechanisms of nerve cell excitation

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 72

TOPIC TAGS: neuron, ion theory, biopotential

ABSTRACT: The ion theory is presently considered as the basic theory explaining a single act of excitation of a nerve cell. However, electrophysiological studies of cell excitation processes under different artificial ion environments and under ionophoresis in the cell of ions of different substances have produced experiments which do not confirm the ion theory. The present report gives a formalized mathematic theory of nerve cell excitation which considers the dynamics of ion conductivities of the membrane. This theory is used to explain data on distortion in the form of the action current and change in the time of spike appearance obtained in experiments with different ion environments. The mathematic investigation makes it possible to determine certain mechanisms of shift in the threshold functioning of the cell. These mechanisms are the basis of adaptive characteristics, and are treated in terms of the relationship of the exciting and inhibiting ions and in terms of change in the mutual sensitivity of these opposite ion mechanisms.

117.

AUTHOR: Krasin, L. A.; Motsnyy, P. Ye.; Shugurov, O. A.

ORG: none

TITLE: An analysis of automatic control mechanisms at the input of a reflex arc

SOURCE: AN SSSR. Nauchnyy sovet po kompleksnoy probleme "Kibernetika". Voprosy bioniki (Problems of bionics) Moscow, Izd-vo "Nauka", 1967, 411-415

TOPIC TAGS: spinal cord, neuron, reflex activity, nerve fiber, biopotential, automatic control system, peripheral nervous system, depolarization, negative feedback

ABSTRACT: Automatic control systems play an important role in the control of reflex processes; this is especially true in the case of a system with a negative feedback (see Fig. 1) causing presynaptic inhibition at the input of a reflex arc of the spinal cord. As a result of this action mechanism, following the passage of a single nervous impulse, prolonged depolarization of the primary afferent fibers appears and this leads to a reduction of the amplitude of the response to the next stimulus. Primary afferent depolarization (PAD) starting in 3-4 msec after the appearance of an afferent volley in the spinal cord reaches its maximal value during the 15th-20th millisecond and decreases to zero during the 250-300 msec. Dynamics of PAD may be followed by sending into the spinal cord two successive impulse volleys with a changing time interval between them. Such experiments staged on anesthetized cats showed that increase of time intervals between the first (conditioning) stimulus and the second (test) stimulus applied to various nerves reduces the amplitude of the first negative ( $N_1$ ) component of the potential of the dorsal surface of the spinal cord in response to a test stimulus (see Fig. 2). The  $N_1$ - component of the PAD reflects the activity of the C-neurons activated by the primary afferent fibers, and depolarization of the presynaptic endings of the afferents is induced by the D-neurons. On the basis of experimental data a curve expressing the degree of inhibition on time and amplitude of response to the preceding stimulus was determined, and an empirical expression describing the dependence is given. Primary afferent depolarization is important in the process of regulating the amplitude of potentials at the input of the spinal cord. With this type of control system, stabilization of PAD amplitude is achieved in a case when rhythmic stimuli are applied to a corresponding nerve. With application of a series of impulses of a given frequency to a peripheral nerve, decrease of response amplitude to each subsequent stimulus takes place; following a transitional process the amplitude of the response reaction becomes stabilized at a constant level for a given frequency (see Fig. 3). The nature of the transitional process and level of amplitude stabilization depends on the succession rate of the stimulating impulses. The amplitude stabilization mechanism of the  $N_1$ - component of PAD may have important protective functions which at high frequencies of stimulation may decrease the value of the energy in the nerve or prevent the appearance of muscle tetanus without complete inactivation of the reflex arc. Investigation of processes in the central nervous system and viewing them from an automatic control theory standpoint may be

helpful in studying the structure of nerve networks and the interaction of neurons.  
Orig. art. has: 3 figures and 8 formulas.

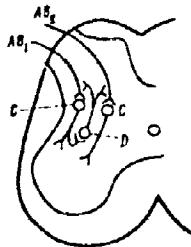


Fig. 1. Feedgack mechanism at the input of the reflex arc.

$AB_1$ --primary afferent fiber n. peroneus  
comm;  
 $AB_2$ --n. popliteus;  
C--"C" neurons;  
D--"D" neuron.

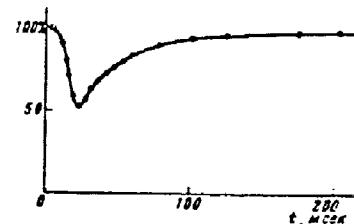


Fig. 2. Dependence of amplitude of  $N_1$ -component of PAD on time interval between single conditioning and test stimuli.

Horizontal axis--time interval between stimuli; vertical axis--response amplitude (in % compared to initial value) based on mean values of 16 experiments.

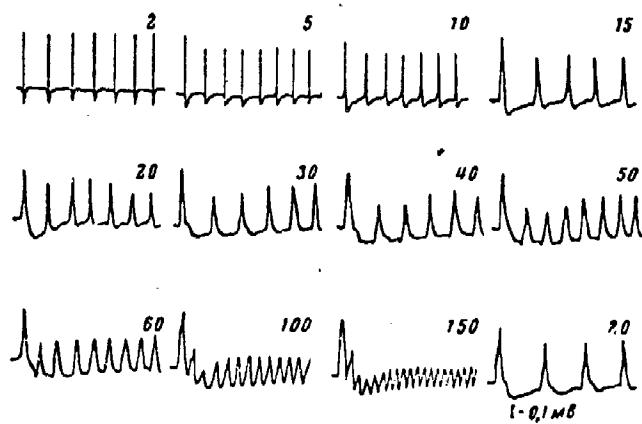


Fig. 3. Dependence of amplitude of  $N_1$ - component of PAD on time of stimulus application with different succession rates of stimuli.

2,5.....150--number of impulses per second.

118.

AUTHOR: Krayzmer, L. P.; Matyukhin, S. A.

ORG: none

TITLE: Structure and reliability of memory neuron networks

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 74

TOPIC TAGS: neuron, human memory, computer simulation, digital computer

ABSTRACT: The reliability of preservation in time of information in the neuron networks of biological organisms depends on a number of factors including the following: 1) the methods and reliability of interneuron connections; 2) the structure of individual memory traces; 3) the principles of interaction of different memory traces; and, 4) the general hierarchy of the memory system. The present work examines the second group of factors and investigates the influence of different methods of organization of the neuron network on the reliability of information stored. Several different types of deterministic and probability networks are examined, their functional properties being studied by simulation on a digital computer. The structure of the networks and the methods of formation of memory traces were based on known biological data. Extirpation of a section of the medullary substance was simulated on the model. Statistical characteristics which demonstrate the reliability of the networks in relation to the principles of their organization were constructed from the results of simulation.

119.

AUTHOR: Kruglikov, I. T.; Nikiforov, V. K.; Ogorodniy, V. V.

ORG: none

TITLE: Some aspects of the integration of synaptic effects by a central neuron

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 77-78

TOPIC TAGS: neuron, biopotential, computer simulation

ABSTRACT: The interaction between separate regions of unipolar and heteropolar changes in the potential of the soma-dendrite neuron membrane was investigated by computer simulation of the generation of exciting and inhibiting postsynaptic potentials and the origin of the discharge in a central neuron. It was demonstrated that the dimensions, localization, and interaction of separate regions of change in the transmembrane potential can determine to a significant extent the minimal total value of the exciting volley necessary for generation of peak potential by the neuron. The optimal spacing and correlation of the relative intensities of inhibiting (hyperpolarized) changes in the membrane potential, which enable the suppression of discharge generation for a specific exciting volley with a minimal inhibiting signal, were similarly determined for certain concrete cases. The effect of the initial level of the membrane potential on the nature of the interaction of regions of depolarization and hyperpolarization and on the generation of peak discharge was examined.

120.

AUTHOR: Kruglikov, I. T.; Ogorodniy, V. V.; Nikiforov, V. K.

ORG: none

TITLE: Role of intrasynaptic and intersynaptic processes in regulating the effectiveness of an afferent volley

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 77

TOPIC TAGS: neuron, information processing, signal transmission

ABSTRACT: An analysis is made of the possible participation of homosynaptic depression, posttetanic potentiation of presynaptic inhibition, and time and spatial summation in processes regulating the effectiveness of the afferent signal's transsynaptic action. The correlation between the space-time configuration of the distribution of activated synapses on the soma-dendrite neuron membrane and the effectiveness of transsynaptic action was investigated. General regularities providing optimization of the stimulus-reaction correlation were determined, certain particular cases of this process were examined, and its role in the integrated activity of the neuron was demonstrated. The data confirm the hypothesis on the possibility of preliminary processing of afferent information in the approaches to the central neuron in the presynaptic and intrasynaptic structures of the input.

121.

SINGLE NEURON REACTIONS OF DIFFERENT BRAIN AREAS OF CATS TO ADEQUATE STIMULATION OF THE VESTIBULAR APPARATUS WITH MOVEMENT

ORG: none

Kutateladze, M. G. AN SSSR. Izvestiya. Seriya biologicheskaya, no. 4, 1967, 631-633. AP7022859

Experiments were performed on 89 adult cats weighing 2 to 4 kg to investigate 341 neuron reactions of the frontal suprasylvian gyrus, ectosylvian gyrus, middle ectosylvian gyrus, and middle lateral gyrus. The animals under ether were fixed motionless in a stereotaxic device, and glass microelectrodes were implanted. A 20% glucose solution (5 to 6 ml) was administered intravenously to the animals to ensure a good functional state. A UBP-1-01 amplifier, a Sanei oscillograph and a magnetic recorder were used to record neuron biopotentials. Vestibular excitation was produced on a special stand by changing the position of the animal in a vertical direction with acceleration of 0.8 to 1.2 g. Reactions of neurons were classified according to four types (see Table 1).

Table 1. Distribution of neurons according to types of reaction to movement, %

Brain cortex areas	Number of neurons investigated	Type I (Increase of activity of pulses)	Type II (Decrease of activity of pulses)	Type III (Phase changes of pulse activity)	Type IV (Absence of visible pulses)
Frontal ectosylvian gyrus	58	64	-	-	36
Middle ectosylvian gyrus	74	24	54	9.3	12.7
Middle lateral gyrus	89	60.7	24.7	4.5	10.1
Frontal suprasylvian gyrus	120	70	20	-	10

For a more meaningful interpretation of data, a correlation analysis method was used. The correlation between pulse frequency change (change of intercommisural distance) and acceleration value change was determined. Correlation analysis results show that the neurons of the frontal suprasylvian gyrus respond specifically to motion effect and that responses of the other neurons are nonspecific. It is concluded that the frontal suprasylvian gyrus is responsible for the cortical control of the utricular otoliths of the vestibular apparatus. [06]

UDC: 611.813.1:611.85

122.

AUTHOR: Maksimenko, L. A.

ORG: none

TITLE: Analysis of the stability of certain mechanisms for control of the spinal cord

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 88

TOPIC TAGS: neuron, spinal cord, reflex activity, automatic control system

ABSTRACT: The transmitting functions of mechanism for control of the multicircuit system of regulation acting on the input of the multineuron reflex arc of the spinal cord are analyzed. Poles of the transmitting functions are determined and holographs of standardized frequency characteristics of the mechanisms examined are constructed. The effect of synaptic delays of neurons on the stability of a multicircuit system of regulation is investigated, and the limiting conditions of stability are determined.

123.

AUTHOR: Mel'nicuk, P. V.; Zav'yalov, A. V.; Arushanyan, E. B.

ORG: none

TITLE: The relation between the background and induced activity of two adjacent spinal intermediate neurons

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 95-96

TOPIC TAGS: cat, neuron, sensory motor area, biopotential, correlation function

ABSTRACT: For purposes of future investigations of neuron groupings in specific functional centers of the spinal cord, an analysis was made of the correlation of rhythmic background and induced activity of 25 pairs of adjacent intermediate neurons of the spinal cord of anesthetized cats. The dorsal lumbar root, the ipsilateral and contralateral motor zones of the cortex, and the bulbar reticular formation underwent stimulation. Biopotentials from adjacent neurons were recorded extracellularly with one microelectrode, and correlation in the activity of a pair of cells was studied by comparing the durations of interimpulse intervals of both neurons. The duration of interimpulse intervals of individual cells under conditions of background activity

varied within broad limits, the coefficient of variation changing from 5-50%. In most cases changes in the intervals between spontaneous discharges of a single neuron were not combined with oscillations of this indicator in another cell. A statistically reliable correlation was discovered only in the work of five pairs of neurons. Completely different interrelations were found in comparison of variation series composed of mean values of interimpulse intervals from each of the 25 pairs of investigated cells. The correlation coefficient attained +0.71 ( $P < 0.01$ ). The regression coefficients  $R_{xy}$  and  $R_{yx}$  were respectively equal to 0.89 and 0.56. Consequently the activity level of adjacent neurons is almost always coadjusted to a specific degree. The average duration of interimpulse intervals of a single spontaneously discharging cell can not differ sharply from the mean intervals of another one. This indicates that different neurons entering into the composition of a specific functional center experience some diffuse unidirectional influences. The coadjustability indicated noticeably decreases during stimulation of the dorsal root and of the contralateral motor zone of the cortex, indicating the nonhomogeneity of effects addressed to each of the adjacent neurons. At the same time stimulation of the ipsilateral cortex led only to insignificant reduction of such coadjustability ( $r = +0.62$ ,  $P < 0.05$ ). An analogous relationship appears during analysis of the correlation of interimpulse intervals and of individual cell pairs. Stimulation of the root and the contralateral cortex led as a rule to the neurons of each pair reacting in different directions ( $P < 0.01$ ), whereas stimulation of the ipsilateral cortex and the reticular formations of the brain stem led more often to single-valued responses of both cells ( $P = 0.025 - 0.011$ ). In many cases the direction of the reaction is determined not only by the source of information but also by the initial condition of the cell. For instance, all spontaneously active neurons in which the mean interimpulse interval exceeded 80 msec were relieved during stimulation of the root, and both relieving and inhibiting reactions ( $P < 0.01$ ) were observed during shorter intervals with an identical frequency.

124.

AUTHOR: Keytus, V. Yu.

ORG: none

TITLE: Trainable neuron networks

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 93

TOPIC TAGS: neuron, probability, visual signal, learning process, Markov process

ABSTRACT: The problem of determining an output signal of a stochastic neuron network, after it is trained with a random sequence of images, belonging to two forms was examined. Distributions of probabilities are given for a subunion of neuron inputs to elements of the retina and for the appearance of images in the learning sequence. During training the incentive law was used so that the weight and threshold of the network neurons could be changed within certain given limits. The problem reduces to the construction and investigation of a certain finite Markov chain. Examples and results of computer experiments are presented.

125.

AUTHOR: Nadvodnyuk, A. I.; Kuznetsov, S. A.

ORG: none

TITLE: Nature of neuron interaction in the snail subpharyngeal ganglion

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 98

TOPIC TAGS: neuron, cipotential, snail

ABSTRACT: The electric potentials of neurons and of isolated nerve cell stimuli were recorded with an intracellular microelectrode in the *Helix pomatia* L. subpharyngeal ganglion. The presence was demonstrated of intermediate neurons and associated complexes of nerve cells wherein the rhythm of a leading neuron controls the activity of at least four dependent nerve cells. In several cases an electrotonic effect was found between adjacent nerve cells. The amplitude of an electrotonic potential occurring in response to artificial polarization of the neuron membrane had a linear relation to the potential induced by the electrotonic effect in an adjacent nerve cell. The electrotonic effect does not depend on the direction of the polarizing current, i.e. rectifying properties are not inherent in electrotonic transmission. The coefficient of weakening of electrotonic transmission is equal to 2 and has a complex nature.

120.

AUTHOR: Narushevichus, S. V.; Zhilyukas V. Yu.

C.G: Vilno University (Vil'nyusskiy universitet)

TITLE: Application of brownian movement theory in investigations of the nervous system of the Roman snail

SOURCE: Nezhvuzovskaya nauchnaya konferentsiya po neyrokibernetike, 2d, Rostov-on-Don, 1955. Problemy neyrokibernetiki (Problems of neurocybernetics); materialy konferentsii, v. 2. Rostov-on-Don, Izd-vo Rostovskogo univ., 1956, 55-59

TOPIC TAGS: animal, nervous system, neuron, cell membrane, electric potential, statistics, random process

ABSTRACT: Statistical physics methods are applied to studying neuroelectrical processes. This study illustrates the possibility of using computers in describing the Brownian movement in order to study fluctuations in intercommissure intervals and variations in latent periods. The length of the intercommissure interval is a function of reverse residual hyperpolarization, and fluctuation in the length is a function of variation in threshold and membrane potential. Equations are given describing reverse hyperpolarization and solution of the Langevin equation for intercommissure intervals. The latter theoretical formula was verified experimentally by data on the distribution of intercommissure intervals in the nerve cell of the Roman snail. The higher order of fluctuation in the intercommissure intervals obtained experimentally (5% fluctuation compared to 0.1% from kinetic theory) is explained by variations in the number of passages in the cell; the assumption that sodium ions penetrate the cell in groups of 100 ions is supported by calculations showing that 1 calcium ion stops the passage of about 100 sodium ions. The period of latent reaction to electric stimulus on the foot of the snail was measured, and calculated on the basis of the theory of random movement. Data and theoretical calculations compared favorably. This is indicated to support development of A. B. Kogan's idea on the probability-statistical organization of the brain. Comments were made by Dr. T. Veus (ChSSR) regarding the intercommissure intervals as basic code in the operation of the neuron, and by A. B. Kogan (Rostov) on the groups emergence of ions. Orig. art. has: 2 figures and 5 equations.

127.

AUTHOR: Noymark, G. S.; Chubarov, A. V.

ORG: none

TITLE: Mathematic basis of an hypothesis of EEG causality

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 102

TOPIC TAGS: EEG, neuron, biopotential, mathematic analysis

ABSTRACT: A mathematic description of the electric expression of the excitation process of a group of neurons is proposed, based on consideration of the EEG as the result of summation of the postsynaptic potentials of individual neurons. It is assumed that increase in the number of excited neurons and in the frequency of their excitation leads to algebraic summation of hyperpolarized and depolarized potentials. Under these conditions, the content of high frequency components must increase and the mean value of the EEG amplitude must decrease.

128.

AUTHOR: Nikolau, E., Belechfanu, K.

ORG: none

TITLE: Random phenomena in nervous systems

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 103

TOPIC TAGS: nervous system, random process, muscle physiology, nerve fiber, behavior pattern

ABSTRACT: Investigation of striated muscles indicated that with a constant force of contraction their number of functioning fibers remains constant, in spite of changes in the muscle units found in a condition of rest or action. This is explained by a neuron network with random action. In the ontogenesis of the nervous system its activity was apparently organized on probability based on individual experience. Adaptation of certain strategies in which random factors are very important is noticed in the behavior of the adult human. During sorting and processing of information stored in the memory, random factors show up in the nervous system in states of both sleep and wakefulness.

12..

AUTHOR: Nudel', M. B. Tempol'man, A. A.

ORG: none

TITLE: Self-regulation of the speed of excitation propagation in neuron networks

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 106-107

TOPIC TAGS: neuron, reflex activity, brain, central nervous system, self regulation

ABSTRACT: Using the latent period of the knee reflex, the speed of excitation propagation in neuron networks was studied in relation to change in the functional condition of the nervous system under the effect of adequate loads and traumatic brain lesions. A statistically significant relationship of the latent period to external influences on the higher regulating sections of the central nervous system was experimentally established. Self-regulation of the speed of excitation propagation occurs in the neuron network, with a substantial role belonging to the brain. Some principles for the relationship of individual links of this self-regulating system were established.

130.

AUTHOR: Petunin, Yu. I.; Chorayan, O. G.

ORG: Voronezh University (Voronezhshiy un-t); Rostov University (Rostovskiy un-t)

TITLE: Investigation of impulse activity of neurons by random process theory methods

SOURCE: Mezhdunarodnaya nauchnaya konferentsiya po neyrokibernetike, 2d, Rostov-on-Don, 1965. Problemy neyrokibernetiki (Problems of neurocybernetics); materialy konferentsii, v. 2, Rostov-on-Don, Izd-vo Rostovskogo univ., 1965, 59-64

TOPIC TAGS: neuron, random process, mathematic analysis, statistical analysis, visual physiology

ABSTRACT: A study was undertaken to explain changes in random processes, describing impulse activity of neurons in the presence and absence of stimuli. The impulse activity of a neuron can be described by a time series, designated by  $\xi(t)$ , where  $t$  assumes a discrete set of values  $t_1, t_2, \dots, t_n$ . From the probability-statistical principle of neuron organization,  $\xi(t)$  is a random process with discrete time. Factors affecting the random nature of neurons are pointed out. The nerve centers are considered random fields;  $x_1, x_2, x_3$  designate the coordinates of a neuron in a given nerve center, and the position of the center is considered determined if all probability characteristics of the random process  $\xi_{x_1, x_2, x_3}(t)$  are known.

Probability characteristics of the various multidimensional random processes should also be known. The random process may be statistically analyzed if it is stationary or almost stationary. Analysis of the random process describing spontaneous neuron activity of the optic portion of a frog brain showed that the stationarity indicator did not fall outside of confidence limits in any of the investigated confidence levels. Calculations showed that the stationarity of the impulse process describing impulse activity of the optic portion of a frog brain is disturbed if the retina is illuminated. The disturbance is temporary, during initial period of stimulation. The impulse activity then becomes stationary again, but has other probability characteristics than the prior background activity had. Change in the process during the initial period is expressed by the appearance of a trend; the process becomes stationary after elimination of the trend, carried out by the system of linear regression using the method of least squares. A polynomial of the third power was taken as the shift, and in the case of polynomial shift, estimates obtained by the method of least squares appeared effective. Correlograms and pericograms for random processes of one neuron of the optic portion of a frog brain were determined in this way in the presence and absence of stimuli. Possible application of the obtained results is mentioned--use of statistical analysis of a process (neuron impulse activity, EEG, ECG) to expose relationships which are not readily apparent. Orig. art. has: 1 table and 1 formula.

131.

AUTHOR: Petunin, Yu. I.; Chorayan, O. G.

ORG: none

TITLE: Some features of the functioning of the nerve cell as a homeostatic system

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 114

TOPIC TAGS: nerve cell, homeostasis, frog, brain, biopotential, probability

ABSTRACT: The nerve cell is examined as a homeostatic system with specific and nonspecific mechanisms for stabilization of basic parameters. Features of the nature of formation and extinction of a neuron reaction were investigated based on the example of high frequency discharges "spontaneously" appearing in the background activity, or of impulse potentials induced by adequate or inadequate stimulation of neurons of the frog midbrain. The results indicate specific differences in the growth phase and decrease phase of the neuron reaction. Possible mechanisms causing these differences were considered, and an attempt was made to find statistic indices which distinguish various phases of the neuron reaction. The correlation of probability and uniquely determined factors in nerve cell activity is examined in various phases of the neuron reaction.

132.

AUTHOR: Polkovskiy, A. N.

ORG: none

TITLE: Potential possibilities of analysis of electroencephalograms

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 119

TOPIC TAGS: EEG, neuron, mathematic model, mathematic physics

ABSTRACT: The state of the central nervous system is determined by the electric activity of neurons. Since it is not possible to measure the activity of all neurons of the central nervous system, it is impossible to obtain complete information about its state. Information about the functioning of structures of the central nervous system can be obtained either with microelectrodes which lead off potentials of individual neurons or microelectrodes which lead off activity from an entire mass of adjacent neurons. In the latter case we obtain information about the integral activity of a large number of neurons. However, unambiguous interpretation of this information is impossible. Comparison of possible states of neuron activity with EEG reduces to a nonspecific problem of mathematical physics. By accepting a series of simplifying assumptions and by taking into account cytoarchitectonic and electrophysiological data, it is possible to construct a mathematic model and thereby evaluate the degree of ambiguity in information about the state of neurons. The random mutual disposition of individual neurons and the statistic nature of their electric activity create additional ambiguity.

133.

AUTHOR: Popov, I. V.; Dubrovina, N. I.

ORG: none

TITLE: The relation of statistic characteristics of nerve cell impulse activity to parameters of signals from the external environment

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 122

TOPIC TAGS: frog, nerve cell, visual physiology, biopotential, probability, statistic analysis

ABSTRACT: The hypothesis that any change in a signal from the external environment leads to change in the statistic characteristics of nerve cell impulse activity was verified experimentally by analyzing one-dimensional and two-dimensional distribution functions for probabilities of the duration of interimpulse intervals for neurons of the frog visual analyzer under light flows of varying intensity on the retina. The relationship of the statistic characteristics of impulse activity under transitional conditions, when a modulated flow of light impulses acts on the retina, was investigated. The question of the stationary character of the nerve impulse flow and the problem of analyzing nonstationary impulse flows were examined. Data obtained were compared with results of theoretical analysis of output activity of the nerve cell under the effect of signals from the external environment, and were interpreted from the viewpoint of the hypothesis on the probability-statistic organization of neuron structures.

134.

AUTHOR: Pyatigorskiy, B. Ya.

CORG: none

TITLE: Synaptic organization and spontaneous activity of neurons of the dorsal spinocerebellar tract

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 127

TOPIC TAGS: neuron, biopotential, spinal nerve, spinal cord

ABSTRACT: It is well known that the special neurons of the dorsal spinocerebellar tract are the sole link for information transmission from the muscle and cutaneous receptors of the posterior limbs and trunk to the cerebellum. The majority of these neurons are spontaneously active. On the basis of experiments the author presents the hypothesis that the basic source of spontaneous discharges of these neurons is their activation by receptor elements. Experiments with complete and partial deafferentation of parts of the spinal cord were conducted to verify this hypothesis. In all the experiments part of the afferent fibers were left intact, and passage of impulses along them was periodically blocked during recording of spontaneous activity. The experiments demonstrated that the spontaneous activity of the neurons of the dorsal spinocerebellar tract is determined by the nature of afferent impulsion and by the weight value of the synaptic input through which it enters. Statistic analysis of interimpulse intervals of spontaneous activity with different variants of deafferentation makes it possible to evaluate the weight of different synaptic inputs. Changes in the statistic parameters of spontaneous activity can be used as tests for evaluating the functional state of the neuron under different electric and chemical effects on its somadendrite region and presynaptic endings.

435.

AUTHOR: Roytbak, A. I.

ORG: none

TITLE: Formation mechanism of traces of nervous activity

SOURCE: Vsesoyuznaya konferentsiya po neirokibernetike, 3d. Rostov-on-Don, 1967. Problemy neirokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 130

TOPIC TAGS: cerebral cortex, dendrite, calcium, magnesium, biopotential, ion concentration, human memory

ABSTRACT: Changes in the correlation of  $\text{Ca}^{2+}$  and of  $\text{Mg}^{2+}$  concentrations in intercellular fissures of the cortex of the large hemispheres exert strong influence on excitation transmission in the synapses. In minimal concentrations  $\text{Ca}^{2+}$  strengthens and  $\text{Mg}^{2+}$  weakens the dendrite potentials of the cortex, and the effect lasts for several tens of minutes (Roytbak, Chianini, 1967). It can be assumed that change in the ion composition around the presynaptic endings after their excitation plays an important role in the origin of the nervous activity traces on which new memory is based. According to morphological, neurochemical, and electrophysiological data activation of the neuroglial cells associated with a complex of neurons occurs during excitation of the latter. One of the established functions of the oligodendrocytes is the formation of myelin. The author hypothesizes that the activity of oligodendroglia leading to myelinization of the presynaptic terminals plays an important role in reinforcement of nervous activity traces.

136.

AUTHOR: Safonov, V. A.; Durinyan, R. A.

ORG: none

TITLE: Some features of the functional organization of the respiratory center

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 134-135

TOPIC TAGS: respiratory system, brain, neuron, drug effect, adrenolytic drug

ABSTRACT: Results of experiments demonstrated that when inspiratory neurons are stimulated through the entire inspiration phase with the maximal frequency of impulses at the end or middle of the volley, rhythmic activity is preserved under adrenalin apnea and the duration of the volleys and quantity of impulses in them substantially increase. In other groups of inspiratory neurons whose discharges also last through the entire input phase without a clearly expressed maximum of impulsation frequency, activity during apnea either ceases or becomes continuous. Expiratory neurons lose the capacity to generate rhythmic discharges in the period of adrenalin apnea and activity is completely absent in the overwhelming majority of expiratory neurons after cessation of respiratory movements. The initial form of the activity of respiratory neurons is usually reestablished after renewal of independent respiration. The absence of respiratory movements in the period of adrenalin apnea is apparently explained by disruption of interrelations between inspiratory and expiratory groups of neurons of the medulla oblongata respiratory center.

137.

AUTHOR: Shul'gina, G. I.

ORG: none

TITLE: Background impulse activity of rabbit cerebral cortex neurons in development of conditioned reflexes

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 168-169

TOPIC TAGS: conditioned reflex, neuron, cerebral cortex, rabbit, EEG

ABSTRACT: Background impulse activity and reactions of 120 neurons of the sensorimotor, auditory, and visual regions of the cerebral cortex of unanesthetized and unrestrained rabbits were thoroughly analyzed. Prolonged observation of background impulsion reveals that a considerable part of the neurons have great stability of frequency and distribution in time both before and during the period of conditioned reflex development. However, analysis of background impulsion in different groups of neurons revealed a number of directional changes in its parameters under the effect of combinations. The neurons can be divided into two basic groups according to degree of relationship between reaction to applied stimuli and intensity of background impulsion: 1) neurons with stable reactions which do not change essentially in proportion to stimulus repetition; and, 2) neurons with variable reactions which gradually weaken in proportion to stimulus repetition. The expressiveness of the reactions of these neurons was usually associated to some extent with the level of their background impulsion. The appearance or intensification of a tendency to grouping of impulses into bundles was observed when conditioned or unconditioned stimuli of rhythmic stimulation were applied to a number of neurons in the period of reflex development. The frequency of appearance of bundles usually corresponded to the basic frequencies of the EEG spectrum for the rabbit cerebral cortex (2-10 cps). Changes in background impulsion during reflex development apparently reflect processes of distribution of tonic excitation flows connected with formation and reinforcement of conditioned reflex functional systems of neurons. These systems provide an adequate reaction to the stimulus, which acquires new information significance for the organism.

.8.  
AUTHOR: Skrebitskiy, V. G.

ORG: none

TITLE: Specific and nonspecific inhibition of neurons of the visual cortex of the rabbit brain

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Kostovskogo univ., 1967, 139

TOPIC TAGS: rabbit, neuron, visual perception, cerebral cortex, biopotential

ABSTRACT: The response to a flash of light of a large part of the neurons of the rabbit visual cortex includes an inhibiting pause having different latent periods and durations. Intracellular recordings demonstrated that both short and long latent inhibiting pauses are accompanied by development of an inhibiting postsynaptic potential. Short latent inhibiting postsynaptic potentials (with a latent period of 15-25 msec and a duration of 15-25 msec) are characterized by a steep leading front and a more sloping rear front on which one or several peak potentials can appear. Still another inhibiting postsynaptic potential is often recorded following the peak potential, and an impulse discharge is recorded after the inhibiting postsynaptic potential. Such a sequence of inhibition and activation periods is characteristic for responses of the visual cortex to light flashes. Long latent inhibiting postsynaptic potentials (with a latent period of 40-70 msec and a duration of more than 100 msec) have a sloping leading front and a steep rear front on which peak potentials are also recorded in the form of postinhibiting output. An interesting feature of these inhibiting components of the response is the correspondence of the time and duration of their focal potentials arising in response to the light flash. Response of a considerable part of the neurons of the visual cortex to action of different nonvisual stimuli consists of inhibiting their spontaneous activity and their light induced activity. Preliminary data obtained indicate that this nonspecific inhibition is not accompanied by development of an inhibiting postsynaptic potential. Nonspecific inhibition is accompanied by suppression of both impulse discharges and inhibiting postsynaptic components of light responses.

139.

AUTHOR: Smil'gevichus, A.; Marushovichus, S.

ORG: none

TITLE: Reactions of spontaneously functioning nerve cells to external stimuli

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 140-141

TOPIC TAGS: biopotential, snail, neuron

ABSTRACT: Investigations were conducted on neurons of the subpharyngeal ganglion of *Helix pomatia* L. The biopotentials were measured with intracellular microelectrodes, and the left, right, or both pallial nerves were stimulated in the course of 5-45 sec with serial impulses of various parameters. The following types of reactions were obtained: 1) under stimulation the general level of the mean interspike interval decreases, and only the first interspike interval after the stimulus is larger than the mean--this reaction is sometimes absent; 2) the spread of the interspike interval increases at the start of stimulation for the same duration as the mean interspike interval; 3) slow growth of the interspike interval with a large spread occurs with stimulation, and after cessation of stimulation there is a slow return to the norm within 15-25 sec; and, 4) some neurons react only to switching on and switching off the stimulus by decrease of the interspike interval. These reactions are explained on the basis of hypothetical circuits which have posttetanic synaptic activation.

140.

AUTHOR: Sokolenko, P. T.; Samarin, A. I.

ORG: none

TITLE: Time functions in neuron networks with feedback

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don. 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 141

TOPIC TAGS: neuron, feedback, learning process, self regulation, mathematic logic

ABSTRACT: Based on recent data from electrophysiology, the real neuron can be considered as an analog-discrete converter. The work of the neuron cannot be adequately described by Boolean or multiple value logical functions, and neurons and networks with feedback cannot generally be described without using time logical functions. Since the excited neuron generates impulses of constant amplitude and

duration, it would soon that a set of time Boolean functions could be used to describe its work, but the time and spatial summation occurring at the neuron inputs require application of a set of multiple value logic. The present report considered the results of using a set of time logical functions to describe the work of neuron networks and examined certain properties of neurons with closed loops. Time logical functions make it possible to investigate the work of networks in which the value of some of the neuron thresholds depends on the states of other neurons or on past input effects, and this in turn can lead to describing processes of learning and self adjustment in the neuron networks.

AUTHOR: Storozhuk, V. M.

ORG: none

TITLE: Functional organization of the output of the cat primary somatosensory cortex

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 143

TOPIC TAGS: cat, nerve fiber, neuron, cerebral cortex

ABSTRACT: Upon stimulation of nerves of a front leg, 393 neurons of a limited section of the primary somatosensory cortex responded with latent periods within 6-52 msec; 65% of the neurons began generating impulses in the positive phase of the primary response 6-16 msec after stimulus application. Study of the latent periods of responses to stimulation of the same nerves in identified pyramidal neurons demonstrates that this section of the cortex sends three responses into the pyramidal tract via different groups of neurons. These responses are: 1) a small part (10%) of the identified pyramidal neurons generates an urgent response with a latent period of 6-9 msec apparently linked with direct thalamic activation of pyramidal neurons, bypassing the intercalary neurons of the cortex; 2) a large part (75%) of the identified pyramidal neurons participates in the basic response 14-23 msec after the stimulus, i. e. within 3 msec after entrance of the signal into the cortex. This time is sufficient for the signal to pass through four or five successive cortical neurons; and, 3) an insignificant number of neurons participate in a supplementary response which appears 30-40 msec after stimulus application. A finer gradation within the limits of each response is apparently realized by the speed of passage along the fibers. Neurons whose fibers have different speeds of passage (6.4-11, 13-22, and 30-45 msec) participate in each of the three responses.

THE FUNCTIONAL ORGANIZATION OF NEURONS DURING AN EPILEPTIFORM DISCHARGE

ORG: Laboratory of Biophysics, Rostov University (Laboratoriya biofiziki, Rostovskiy universitet)

Sukhov, A. G. Mezhvuzovskaya nauchnaya konferentsiya po neyrokibernetike, 2d, Rostov-on-Don, 1965. Problemy neyrokibernetiki (Problems of neurocybernetics); materialy konferentsii, v. 2. Rostov-on-Don, Izd-vo Rostovskogo univ., 1966, 208-212. AT7033549

The neuron organization of focal epileptiform discharges was studied to determine the relationships between neurons under various conditions of CNS activity, particularly during intense stimulation. An analysis was made of the impulse activity of 70 neurons under various conditions cortex of a white rat, recorded during focal epileptiform activity. This activity was characterized by two- or three-phase peaks (frequency—3—4 peaks/sec; duration—50—100 msec). Two general types of neuron activity were identified. Impulse activity increased in the first type and decreased in the second type. Sixty percent of the cases were of the first type, 30% were of the second, and 10% could not be classified. The type of activity found in any one neuron varies for a number of reasons. One factor determining the type of activity in a given neuron is the point of application of the stimulus. During repeated attacks, if the same point on the cerebral cortex is stimulated, only 10% of the neurons will show a change in activity. If two different points are stimulated, the activity of 33% of the neurons will be altered. If a stimulus is given at three points, there is an activity change in 47% of the neurons. The electrocorticographic picture of the attacks, however, does not change. The experimental data substantiated theoretical predictions. The similarity in distribution of experimental and theoretical data indicates the possibility of a relationship between the neurons, determined by statistical distribution of stimulated and inhibited neurons under normal conditions and during intense stimulation (i.e., epileptiform activity). [LS]

143.

AUTHOR: Sukhov, A. G.

ORG: none

TITLE: Some mechanisms for selecting a signal from random oscillations of background impulse activity

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 143-144

TOPIC TAGS: neuron, bioelectric phenomenon, cerebral cortex

ABSTRACT: Reactions of neurons to a standard stimulus under spontaneous or artificial change in background activity frequency were investigated. Stimulating reactions with infrequent (up to 10 impulses/sec) background activity and inhibiting reactions with frequent (above 30 impulses/sec) background activity predominated. Stimulating reactions with subsequent inhibition also occurred for a mean 10-20 impulses/sec frequency of background activity of cortical neurons, which is optimal for clear detection of both signal phases. This two phase reaction of the majority of cortical neurons is relatively independent of random changes in impulsion frequency and can be reliably selected from the contrasting inconstant background. It is supposed that the separate stimulating or inhibiting phases of the signal, which have gained predominance in individual neurons because of random reduction or extinction of their background activity, can be mutually summarized at the output of the neuron ensemble, hypothetically on large pyramidal cells, and can statistically reconstruct a reliable picture of an already amplified and partially processed signal.

144.

AUTHOR: Sysoyev, V. V.

ORG: none

TITLE: New concepts of the refractivity of excited structures

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 144

TOPIC TAGS: nerve, neuron

ABSTRACT: It appears necessary to introduce the concepts of a standardized effective refracting period and a natural effective refracting period because the duration of the effective refracting period depends on the parameters of the testing stimulus. The relation between the effective (or functional) refracting period and the lability coefficient determined by Ukhtomskiy (1934) is examined. The lability coefficient must show the lower limit of the set of values of the effective refracting period, which period characterizes a given excitable structure in a given functional state depending on the rhythm of activity. Difficulties in measuring the effective refracting period, the natural effective refracting period and the total refracting period are examined, and recommendations are made for determining the refractivity and lability of excited structures.

145.

AUTHOR: Tereshkov, O. D.

ORG: none

TITLE: Some principles of the structural-functional organization of the nervous system of annelids

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 147

TOPIC TAGS: nervous system, annelid, central nervous system, peripheral nervous system, feedback, biologic model

ABSTRACT: Afferent information about states of the external environment and individual organs enters the animal central nervous system by undergoing considerable divergence, caused by initial information processing in the peripheral nervous apparatuses. Efferent information entering the animal effector organs is the result of a significant convergence of signals descending from the central nervous system, caused by activity of the peripheral nervous apparatuses in decoding central commands. A ganglionic accumulation of nerve cells in the lateral nerves of the leech (Kuslyenko and Tereshkov, 1967) can serve as an example of such a peripheral apparatus for

afferent information encoding and efferent information decoding. Closed-loop feedback circuits function in the entire system and enable the organism to adapt effectively to the external environment. These principles of general structural-functional organization and other features of the nervous system of annelids make it a prospective model for studying the organization of the nervous system of higher animals.

140.

AUTHOR: Tolkunov, B. F.

CORG: none

TITLE: Statistical characteristics of background and induced activity of neurons of brain reticular formations

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 149-150

TOPIC TAGS: neuron, brain, rat, statistic analysis, probability

ABSTRACT: The background activity of central neurons and especially of neurons of reticular formations of the brain can be considered as the result of interaction of three basic factors: the individual features of the neuron, the nature of interneuron connections and of the relationships inside the functional complex, and the afferent flow to the neuron. The abundance of synaptic contacts on the neuron surface and the broad divergence and convergence of input signals in the reticular formations allows the assumption that afferentation to an individual neuron approximates a random flow of impulses. Such impulse flows can be investigated by statistical analysis. The background activity of central neurons and the nature of its changes during stimulation were investigated in rats by constructing interval histograms, poststimuli histograms, expected density histograms, and postimpulse probability curves. Each neuron had an interval histogram of the constant type. All neurons were divided into two types depending on the nature of their postimpulse probability curve, namely, neurons whose postimpulse probability curve passed through a maximum and neurons whose postimpulse probability curve did not have a clearly expressed maximum. These two types were represented to different degrees in various brain formations. Reaction to external stimulation was accompanied by rearrangement of the interval histogram when prolonged change in neuron activity in the postimpulse period was found in the poststimuli histograms. The expected density histogram characterizing the distribution of neuron discharges in time was a more variable characteristic of neuron activity. Comparison of the interval histogram and the expected density histogram demonstrated that the statistical distribution of interimpulse intervals and their time organization can change independently and to all appearances may be the result of different mechanisms.

147.

AUTHOR: Vasilevskiy, N. N.; Trubachev, V. V.

ORG: none

TITLE: Electrophysiological indices and neural learning mechanisms

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Kostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 20

TOPIC TAGS: rabbit, learning mechanism, cerebral cortex, EEG, neuron

ABSTRACT: Electroencephalographic and cellular reactions in the cortex of the large hemispheres of the rabbit during development of temporary connection were investigated on a defensive reflex model. It was demonstrated that the most pronounced dynamics of the EEG at the representation focus of conditioned and unconditioned stimuli are observed in the initial periods of applying and withdrawing one or a combination of indifferent stimuli. On the basis of the data it is assumed that changes in the EEG mostly reflect transitions (adaptation to new conditions) from excitation processes in the brain to local processes. The dynamics of the reactions of type I neurons of the projective system coincide with the phase of transitional processes in the brain. Type II neurons with extended receptive fields display the most characteristic changes of impulse activity during the phases of establishing and reinforcing a temporary connection, when EEG indices are extraordinarily poor. An unusual lightening of impulsation beyond 200 to 500 milliseconds is observed before the start of reinforcing stimulus action. Intensification of activity is partially correlated with low amplitude negative EEG waves and the electropositiveness following them. The results allow us to assume that at least two mechanisms regulating the central processes participate in the learning process. One mechanism determines the transitional processes and the other determines the development of specialized interneuron interactions (closures).

148.

AUTHOR: Vizitey, N. N.; Kuznetsov, S. A.; Debelyy, Yu. D.; Roglan, M. G.

ORG: none

TITLE: Simultaneous microelectrode investigation of several neurons of the cat motor cortex

SOURCE: Vsesoyuznaya konferentsiya po neirokibernetike, 3d, Rostov-on-Don, 1967. Problemy neirokibernetiki (problems of neurocybernetics); referaty dokladov konferentsii, Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 22

TOPIC TAGS: cat, neuron, sensory motor area

ABSTRACT: Simultaneous observation of several nerve cells within a certain section of the cortex of the large hemispheres of a mammal is of interest for understanding the character of the functional relationships between the cells of the most complicated neuron complexes. This investigation was carried out with a device developed in the laboratory which shifts five microelectrodes simultaneously and automatically with visual control of the results of the shift (Vizitey, Kuznetsov, 1965). The article presents results of microelectrode investigation of single neurons and neurograms of background activity of several neurons of the motor cortex of the cat simultaneously recorded extracellularly, and results of change in this activity with sound, light, and mechanical stimulation of the corresponding receptors.

149.

AUTHOR: Vladimirova, I. A.; Storozhuk, V. N.

ORG: none

TITLE: Some characteristics of interneuron relations in the somatosensory cortex

SOURCE: AN SSSR. Nauchnyy sovet po kompleksnoy probleme "Kibernetika". Voprosy bioniki (Problems of bionics) Moscow, Izd-vo "Nauka", 1967, 191-197

TOPIC TAGS: neuron, cerebral cortex, information processing, biopotential, human memory, peripheral nervous system

ABSTRACT: Functional interneuron relationships at the highest analyzer levels in the cerebral cortex were investigated to help elucidate the basic principles of how the nervous system analyzes images of the external world. Though the peripheral sections of the analyzers are quite specialized and differentiated, their cortex sections have much in common in structure and function. On the basis of the latter, the authors hypothesized that information processing in the neuron network of the projective zones of different analyzers can be based on the same general principles. A signal arriving at the cortex leads to the appearance of complex functional relationships between cortex neurons, but even the first moves of the signal in the cortex are not clear. Functional properties of neurons and interneuron relationships in the first projective

zone of the cortex of an anesthetized animal (not specified) were studied. A somatosensory cortex area (3-4 mm) located in the posterior sigmoid gyrus and corresponding to the projection of two different nerves (median and ulnar) of the anterior extremity were investigated. On the basis of 924 recorded neuron responses, 150 neurons were selected for prolonged observation of background rhythm because their response to peripheral stimulation provided material for statistical processing. Evoked responses of the selected neurons were recorded simultaneously with a surface microelectrode. Nineteen of the 150 neurons did not display any noticeable change in background activity despite repeated stimulation. The rest of the neurons were divided into four types according to their characteristic changes (see Fig. 1). Type 1 represented by 81 neurons generated one or several additional extra impulses which generally corresponded to the initial first response. Type 2 represented by 7 neurons evoked in addition to the initial response a group of successive discharges. Type 3 represented by 29 neurons temporarily ceased background activity. Type 4 represented by 14 neurons produced discharges in the initial response period with subsequent temporary cessation of background rhythmicity. Type 1 neurons located at a depth of 1000-1400 microns had a latent period not exceeding 20 msec (range from 7.3 to 52 msec). Type 2 neurons located at a depth of 1150-2170 microns displayed extra discharges 8-36 msec after stimulus application followed by a successive volley in impulses. Type 3 neurons found at a depth of 640 microns displayed responses with background rhythmicity frequency not less than 6 cps and duration of discharge cessation varying from 140 to 450 msec. Resumption of rhythm started with impulses of a lower frequency and initial background was restored only after the third or fourth impulse; the latent period for this type does not exceed 15 msec. Type 4 neurons located at a depth of 370-1580 microns displayed a background rhythmicity of at least 10 cps and the latent period ranged from 7.8-25.5 msec; cessation periods did not exceed 400 msec. The type of response for each neuron was stable, but occasionally neurons changed their type of response; generally, in this case, types 2 and 4 changed to type 1. Considering that the latent period of individual neurons can exceed 50 msec and the response can consist of several impulses, it can be assumed that the initial evaluation of an incoming signal takes place in the first 100 msec. However, the cessation of impulse activity for 400 msec or more, and also the successive discharges of some neurons show that the signal trace, which possibly is related to short term memory, remains for approximately 0.5 sec. Thus, neurons of the first projective zone are capable of preserving signal traces for a short time as well as analyzing signals arriving directly from the peripheral nervous system.

Orig. art. has: 4 figures and 1 table.



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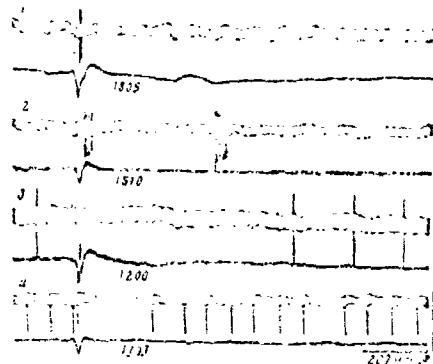


Fig. 1. Types of cortical neuron responses to peripheral stimulation.

- 1---impulses at time of initial response;
- 2---impulses at time of initial response and successive discharge;
- 3---temporary cessation of impulse activity;
- 4---impulse at time of initial response and subsequent temporary cessation of impulse activity.

On each oscillosogram: the upper curve represents the microelectrode lead; the lower curve represents the microelectrode lead from the cortex surface; and, the numbers under the oscillosogram show the depth at which the neuron response was recorded.

150.

AUTHOR: Voronin, L. L. Tanengol'ts, L. I.

ORG: none

TITLE: Synaptic mechanisms of neuron reactions of the cortex motor zone to signals of different sensory modalities

SOURCE: Vsesoyuznaya konferentsiya po neyrofizernetike, 3d, Rostov-On-Don, 1967. Problemy neyrofizernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 26

TOPIC TAGS: cat, cerebral cortex, neuron, sensory motor area, anesthesia, visual activity, tactus, audition

ABSTRACT: Reactions of fifty neurons of the cortex motor zone of the cat under chloralose anesthesia in response to electrocutaneous stimulation of the extremities, light flashes, and audible clicks were investigated with intracellular microelectrodes. In the majority of cases the postsynaptic reactions to all the stimuli had a similar form. The latent periods of the responses were within the limits of 8-30 msec for electrocutaneous stimulation of the anterior contralateral extremity, 18-55 msec for the flashes, and 10-40 msec for the clicks. Regular and similar changes of the postsynaptic potentials, appearing in response to somatic and .

auditory or visual stimulation, were observed with change in the membrane potential. When two stimuli were applied with a small interval between them, the response to the second stimulus was blocked when the interval was less than a certain value (0.1 to 1 sec for different neurons) regardless of the relation of the modalities stimuli. It was discovered that this blocking is not related to postsynaptic inhibition in the cells, but to blocking of the second signal on the way to the cells. It is assumed that signals of different modalities reach neurons of the motor cortex by the same or similar pathways, and the primary interaction of these signals does not take place on the cortical neurons.

151.

AUTHOR: Yefimov, V. N.; Chumachenko, A. A.; Golovatenko, V. P.

ORG: none

TITLE: Some methods for operative analysis of impulse activity of nerve cells

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967. 43-44

TOPIC TAGS: neuron, pulse amplitude, central nervous system

ABSTRACT: Many electrophysiological experiments are based on the method of recording impulse activity of neurons under different effects on the nervous system. Thus it is advisable to develop methods for rapid and precise evaluation and measurement both of background activity and of regular response to this background during application of an effect. The reaction of a neuron to an external stimulus can be characterized as change in its impulsion frequency. A simple plan is proposed for a device called an intervalograph, which converts interimpulse intervals into amplitude and records the corresponding curve with an automatic recorder. Recordings of intervalograms obtained in experiments are presented. The intervalogram makes it possible to find clearly expressed regularities both in background activity (for example, periodicity of one or another type) and in the neuron reaction. A plan is presented for another device based on a method for averaging impulse sequences during multiple repetition of stimulation. The device separates neuron reactions from general backgrounds containing both random and periodic components, and it can also separate latent periodicities of certain types.

152.

AUTHOR: Yefremova, T. M.; Zhadin, N. M.; Kaburneyova, L. I.; Kondrat'yeva, I. N.; Melikhova, A. M.; Shul'gina, G. I.

ORG: none

TITLE: Investigation of correlations of activity of adjacent neurons in the rabbit cerebral cortex

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 44

TOPIC TAGS: rabbit, neuron, cerebral cortex, data correlation, central nervous system stimulant

ABSTRACT: The activity of 213 pairs of neurons of different regions of the cerebral cortex of nonanesthetized and immobilized rabbits was analyzed under the action of different stimuli (light, sound, etc.) and of pharmacological substances (bromine, morphine, caffeine), using a cross-correlation method. In the absence of stimuli or pharmacological substances, a small number of neuron pairs function in a correlated manner — up to 9.6% in the sensorimotor region and up to 15% in the visual region. The distribution of the total number of neuron pairs according to a correlation coefficient indicates reliably nonzero background activity but of a low or average level of synchronization. The synchronism interrelations in the majority of neurons (functioning both in a synchronized and nonsynchronized way) are maintained steady in time both in the background and under weak stimuli. Increase in the number of neuron pairs functioning in a synchronized way is observed under rhythmic light stimulation and during administration of the sedative pharmacological substances bromine and morphine.

153.

AUTHOR: Yemel'yanov, I. P. Popov, I. V.

ORG: none

TITLE: Data on the relation between neuron impulse discharges and oscillations of the slow biopotential

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); reforaty dokladov konferentsii. Rostov-On-Don, Izd-vo Rostovskogo univ., 1967, 42

TOPIC TAGS: frog, statistic analysis, neuron, biopotential, visual perception, brain, phase analysis

ABSTRACT: The statistical relation between neuron impulse activity and the slow electric activity of nerve structures was investigated in the frog by recording the spontaneous electric activity of the contral section of the visual analyzer. The problem was investigated by two methods. The first method provided for study of the statistical properties of one-dimensional distributions of intervals between impulses with subsequent separation of limits for impulse bundles. The connection between impulse bundles and the slow potential phase was studied. The second method was based on a hypothetical connection between the rising and falling fronts of the slow electric potential and the excitability of cortical neurons. An attempt was made to discover and confirm this regularity. The rising and falling fronts of single waves were separated in graph recordings of oscillations of the slow electric potential, and separate counts of impulses for rising and falling fronts were performed. The numerical values obtained were compared and evaluated with a statistic criterion for alternative groupings. The results of the research were considered from the viewpoint of phase relationships in a system of slow gradual regulation of excitability in the brain.

154.

AUTHOR: Yeremenko, I. V.

ORG: none

TITLE: Feasibility of studying processes in neuron networks on the basis of the hypothesized existence of hologram memory

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 42-43.

TOPIC TAGS: neuron, brain, holography

ABSTRACT: There are no known hypotheses for constructing algorithms simulating mechanisms of the entire brain which connect the following basic features of neuron networks: the unfailing presence of rhythmic oscillations in such structures as nerve ganglia of the water bug and human brain; the high speed of response of neuron networks with relatively small rates of ion processes; and, the high reliability of neuron networks, which is not explained by structural redundancy. Methods for obtaining holograms from photographs were created and experimentally carried out on the theoretical basis of processes for restoration of a wave front (Gavor, 1947; Leyton and Upatniyok, 1954). These photographs can be considered as permanent storage memories with indelible recording. Preliminary analysis presented by the author demonstrates that the hypothesis on the existence of hologram memory in neuron networks has a definite value. In accordance with this hypothesis the neuron is examined as threshold element and the alpha oscillations as a group monochromatic stimulus. The hypothesis allows finding a logical connection between the features of neuron structures and the physical interpretation of these and certain other features.

155.

AUTHOR: Zeveke, A. V.; Tatarinov, L. I.

ORG: none

TITLE: Determination of the density distribution of nerve fibers by the frequency of their transmitted impulses

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 50

TOPIC TAGS: nerve fiber, bioelectric phenomenon

ABSTRACT: The distribution of a relative number of afferent fibers can be determined by the frequency of repetition of impulses of naturally induced activity, without resorting to splitting a nerve into individual fibers, using a method of counter (ortho and antidromic) impulses. Methods of calculation were worked out based on analysis of the relationship of amplitudes of antidromic potentials to the interelectrode distance and the moment of stimulus application. However, these methods are limited in use because of inherent measurement errors. Results of experimental determination of a law of distribution of nerve fibers based on orthodromic impulse frequencies are discussed, and a new method of calculation is proposed which eliminates some of the measurement errors.

156.

AUTHOR: Zhilyukas, R.; Marushevichus, E.

ORG: none

TITLE: Statistical characteristics of the spontaneous electric activity of giant neurons of the apple snail in relation to an ion environment and temperature

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 46

TOPIC TAGS: snail, neuron, ion, temperature dependence, bioelectric phenomenon

ABSTRACT: Statistical characteristics, i.e. the mean interspike interval, the mean quadratic deviation, and the distribution of interspike intervals of the spontaneous electric activity of giant neurons of the apple snail (*Helix pomatia*) under different ion environments and temperatures are presented. The spontaneous electric activity of the giant neurons was measured with ordinary microelectrophysiological equipment. A composition of 78 millimols NaCl, 4.5 millimols KCl, 10 millimols CaCl<sub>2</sub>, and 6.7 millimols MgCl<sub>2</sub> served as the initial physiological solution. When Na increased from 78 to 480 millimols the mean interspike interval decreased two to three times more than normal. Without a sodium solution at the start, it increased by five times

and after several minutes the generation of PD ceased altogether. Similar results were obtained when the  $\text{Na}^+$  was replaced by  $\text{Li}^+$ . When the  $\text{K}^+$  was increased to 10 millimols spontaneous activity hardly changed, but an increase to 40 millimols led to considerable changes. When the  $\text{Ca}$  was increased from 10 to 40 millimols the mean interspike interval increased by almost ten times. The mean interspike interval and its mean quadratic deviation depend on the temperature. The mean quadratic deviation of the interspike interval is directly proportional to the mean interspike interval, but the coefficient of variation remains almost constant.

## Sub-Section 2. Neuron and Neural Network Modelling

157.

AUTHOR: Akhmerov, U. Sh.; Yevdokimov, I. Yu.; Sorokin, G. P.

ORG: none

TITLE: Electrical models of single stimulation

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 9-10

TOPIC TAGS: nerve, biologic model

ABSTRACT: Threshold excitation of the nerve is examined in the present work as the start-up of a system. The kinetic law of stimulation is graphically described by a strength-duration curve. Despite quantitative differences in individual indices, the strength-duration curves for different substrates have a number of common features such as a range of minimal intensity and a condition under which minimal energy is expended for the threshold signal. The common properties listed pertain not only to the processes taking place with stimulation of the excitable tissues, but also to many natural phenomena (thermal, hydraulic, electronic, etc.) which can be combined under the general designation of "starters." Models for the start-up of neural excitation based on elements of radio engineering circuits are examined. The first model attains an anodic current with a specific actuating magnitude when the current is turned on. The model is in essence a thermal one, since heat transfer from the filament to the cathode is involved in the start-up stages. The second model is a start-up of the threshold element, switched in to the output of certain resistance-capacitance circuits. The work of these models, like that of many others, is described by the strength-duration curve. In each model are corresponding equivalents and analogies to the processes taking place with stimulation of the nerve. Investigations demonstrate the applicability of the theory of neural stimulation to the analysis of certain moments of industrial starters.

THE ROLE OF THE ORGANIZATION OF SYNAPSES ON DENDRITES IN THE  
"RECOGNITION" OF THE IMPULSE CODE

ORG: Institute of Biophysics, Academy of Sciences USSR, Moscow (Institut biofiziki AN SSSR)

Aladzhalova, N. A. Mezhvuzovskaya nauchnaya konferentsiya po neyrokibernetike, 2d, Rostov-on-Don, 1965. Problemy neyrokibernetiki (Problems of neurocybernetics); materialy konferentsii, v. 2. Rostov-on-Don, Izd-vo Rostovskogo univ., 1966, 110-114. AT7033542

A paper by S. A. Sardarov, N. N. Bogolepov, and V. N. Popova showed the diversity of synapse distribution on the dendrites. Electron micrographs demonstrate that an axon can have several synapses on a single dendrite process. (see Fig. 1). Some synapses are located



Fig. 1. A model of signal recognition of the dendrite branch

1 - synapses projections; 2 - axons;  
3 - bifurcation.

very close to each other, and may have an antagonistic relationship (exciting and inhibiting). A model has been constructed on the assumption that the synapses must be organized into functional systems, because the stimulation of a single synapse cannot have an important effect on the neuron activity. This must be so, since, for example one pyramidal neuron can have as many as  $10^5$  synapses. According to one theory, the algebraic sum of the synaptic stimuli excites the neuron. The authors present a theory that the synapse system of each dendrite process can "recognize" a signal on a "yes-no" basis. That means that a neuron is capable of "recognizing" several signals. It may be supposed that the information is expressed in the central nervous system by a binary code; the impulses are represented by ones and intervals between them by zeros. A signal may then be defined as a group of impulses. Different systems of coding may be possible: ones and zeros might be equally significant, or ones might be more significant than zeros, and vice versa. The length of the impulse or interval could be expressed by a sequence of ones or zeros. Signal perception in the dendrites may be based on the following process. The entering signal changes the function distributing the synapses by state so that a correlation arises between the distribution of impulses and the intervals in the signal (in time) and the distribution of the

synapses according to their state (in space). It is supposed that the shift of the synapses at the signal from a random to a regulated distribution, which is memorization, leaves its traces in the "memory." If the same sequence of impulses follows, the sum of synapse responses at the dendrite output in the bifurcation zone will exceed the level of random noise and recognition will occur. If a false signal containing a different combination of ones and zeros enters, the sum will not exceed the noise level. A simplified device (Fig. 2) illustrates

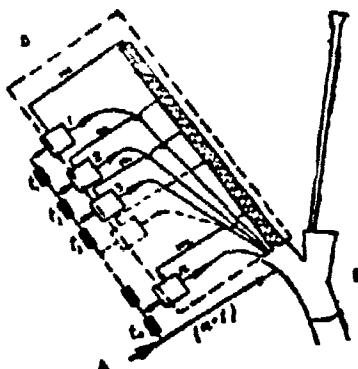


Fig. 2. Diagram of the model

1, 2....n - synapses on the dendrite D; A - axon path; t - chain of impediments; m - response in the bifurcation B to the n + 1st impulse.

the principle of correlation. The axon paths are equipped with a system of impediments  $t$ , which allows simultaneous entry of all the ones and zeros of the signal into the device. After  $n$  units of time, the first impulse (or zero) will be in the first synapse, the second in the second, and the  $n$ -th in the  $n$ -th. A shift in the state of synapses takes place according to this distribution. The threshold of the synapse can be changed by a feedback from the postsynaptic membrane to the presynaptic terminal. This occurs if at the moment when all the ones and zeros have taken places at the presynaptic entrances, an impulse  $m$ , which can be a response of the bifurcation zone to the  $n + 1$ st impulse, enters all the postsynaptic terminals. The direction of the synapse state shift then depends on whether the postsynaptic impulse meets a one or a zero. The imperfection of the device is that a signal containing more ones than the preceding signal, which is stored in the memory, is falsely recognized. In order to overcome this obstacle, the same quantity  $n$  of inhibiting synapses should be added to the stimulating synapses. If a false signal enters into such system, the excessive ones will enter those synapse pairs which previously received zeros. The answer is then negative and appears as a wave of hyperpolarization. Experiments conducted by N. A. Aladzhalova and O. Kh. Koshtoyants in 1962 on the axo-dendrite stria of the cerebral cortex of rabbits demonstrated that an autonomous activity is possible on the axo-dendritic sphere. It is also possible that the flow of information stimulates the development of synapses and further dendrite processes, which may considerably increase the elasticity and the potentialities of the memory. [EF]

159.

AUTHOR: Aladzhalova, N. A.; Shabad, A. Ye.

ORG: none

TITLE: A signal recognition model on the level of the axodendrite sphere of a neuron

SOURCE: AN SSSR. Nauchnyy sovet po kompleksnoy probleme "Kibernetika". Voprosy bioniki (Problems of bionics) Moscow, Izd-vo "Nauka", 1967, 147-153

TOPIC TAGS: dendrite, form recognition, biologic model, learning process

ABSTRACT: Signal recognition is based on organization of synapses on the neuron dendrite (see Fig. 1) into a functional system which is created by the information flow itself. In a formal model (see Fig. 2) organization of the synapses consists of establishing a correlation between impulse distribution in the signal (in time) and the distribution of synapses according to states (in space). The states of the synapses are determined by thresholds and they shift during postsynaptic excitation. An arriving signal induces a redistribution of synapses according to states (memory); and, with repeated presentation of the same signal, the total response of a model will be higher (recognition) than for any other signal presented for the first time. The statistical properties of a model make signal recognition possible and also simultaneous memory of several signals. In one of the model variants, a signal coded in a binary code (ones and zeroes) is processed in such a way that significant information is contained only in the ones. In another variant the signal is processed in such a way that the ones and zeroes are of equal importance. Properties of the model elements are compared with those of neuron axodendrite subsystem elements. Experiments presented on "learning" in the axodendrite stria of the cerebral cortex of rabbits show the gradual formation of dendrite responses with repeated presentation of a stimulus (memory and recognition). Orig. art. has: 4 figures.

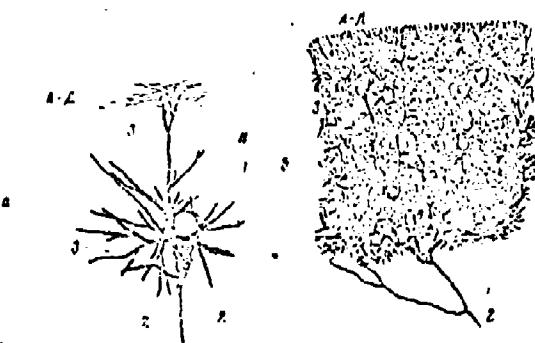


Fig. 1. Neurons and their axodendrite sphere.

a--pyramidal neuron of the cerebral cortex; b--cerebellar neuron (according to Ramon-Kahal');  
1--neuron body; 2--axon; 3--dendrite;  
4--bifurcation zone; A ~ D--axodendrite sphere.

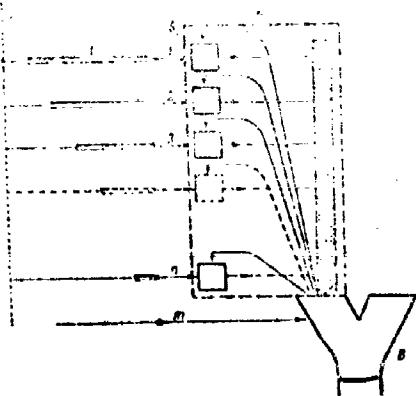


Fig. 2. Diagram of a signal recognition model.

A--input (axon); t--delay;  
 D--recognition cell (dendrite);  
 S--cell elements (synapses);  
 B--summator (bifurcation zone);  
 1, 2, 3...n--order number of characters in the  
 signal code; m--redistributing impulse.

160.

AUTHOR: Bondar, A. A.; Dedosha, L. A.; Reznik, A. M.; Stepanenkov, A. F.

ORG: none

TITLE: Realization of the principle of active learning in an electronic model of a neuron

SOURCE: Vsesoyuznaya konferentsiya po neyrofizike, 3d, Rostov-on-Don, 1967. Problemy neyrofiziki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 14-15

TOPIC TAGS: neuron, biologic model, learning process, transistor

ABSTRACT: The principle of active learning of neurons was investigated in an electronic model using transistors and controlled electrochemical resistors (memistors). The teaching circuit is constructed so that an increase in conductivity of certain neuron inputs reduces the conductivity of the remaining inputs. At the same time, the total impulse activity of the neuron is held at a certain average level. Control of the learning process (reward-punishment) is accomplished by change in the threshold potential of the generator used to form the neuron responses. Experiments in teaching the model to recognize impulse flows demonstrated that about  $10^4$  neuron responses to a learning sequence are required for complete relearning. In the absence of reward, the neuron spontaneously learns recognition of the most often repeated situation. The rate of self-learning essentially depends on the initial state of the neuron. As a rule it is higher in unspecialized neurons which have a uniform distribution of synapse conductivities.

101.

AUTHORS: Davidenko, V. V.; Klyk, V. I.; Korobov, I. I.

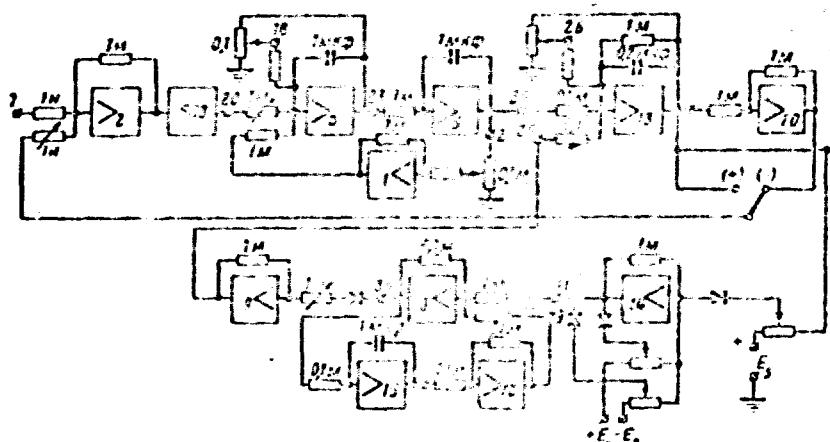
ORG: none

TITLE: Nonlinear properties of neurons and their functional modeling

SOURCE: AN SSSR. Nauchnyj sovet po kibernetike problem "Kibernetika". Voprosy bioniki (Problems of bionics) Merets, Izd-vo "Nauka", 1967, 178-184

TOPIC TAGS: bionics, cybernetics, neuron, biologic model, mathematical model, analog computer, nonlinear effect / MN analog computer (U)

ABSTRACT: Problems related to mathematical modeling of neuron functions are examined. Analysis of the essentially nonlinear properties of excited membranes made it possible to synthesize a universal functional neuron model (see Fig. 1) on an MN-7 analog computer. Analysis of processes occurring in the system by harmonic linearization provides the basic relations determining frequency and amplitude variations. The model reproduces fairly completely and explains satisfactorily all known characteristics of the electrical activity of neurons. No qualitative differences are found between the properties of membranes of neurons of various types.



162.

CONTINUAL DESCRIPTION OF THE FUNCTIONING OF A PULSE-NEURON MODEL

ORG: none

Dunin-Barkovskiy, V. L. Biofizika, v. 12, no. 4, 1967, 746-750.

AP7025622

According to present concepts, individual neurons do not carry information—only average frequencies of pulse transmissions are the variables of the nervous system. The present paper attempts to account for this pulse generation by using the approach of a continual description of neuron action. Mathematical treatment is based on the neuron model described earlier by Lyubinskiy and Pozin (Avtomatika i telemekhanika 26, 1746 (1965)). This model consists of three types of elements: synaptic elements equal in number to the number of neuron inputs, an element for space summation with the number of inputs equal to the same number, and a pulse-generating element. Each element has only one output. The synaptic elements receive pulses which are transformed into the postsynaptic potential. The space-summatting element transforms the postsynaptic potentials from various neuron inputs into the membrane potential which is represented by a sum of a series into which certain coefficients (weights) enter; the positive coefficients correspond to excitation, and the negative, to blocking. The pulse-generating element transforms the membrane potential into pulses. An analytical presentation for the output pulse is given by approximating the summation by integration, and the error of this approximation is evaluated. [06]

103.

AUTHOR: Fil'kov, V. G.

ORG: none

TITLE: Circulation of pulses in a line that simulates a nerve-cell axon and is closed in a ring

SOURCE: AN SSSR. Nauchnyj sovet po kompleksnoy probleme "Kibernetika". Voprosy bioniki (Problems of bionics) Moscow, Izd-vo "Nauka", 1967, 185-191

TOPIC TAGS: bionics, cybernetics, neuron, biologic model, nerve cell, transmission line, differential equation solution, linear differential equation, tunnel diode storage

ABSTRACT: An elementary prototype of a memory element on a single neuron is examined from the point of view of pulse circulation. The behavior of currents and voltages in the line (see Fig. 1) is described by

$$\begin{aligned} -\frac{\partial U}{\partial x} &= L_1 \frac{\partial I}{\partial t} + R_1 I, \\ -\frac{\partial I}{\partial t} &= C \frac{\partial U}{\partial t} + i_1(U) + \frac{1}{L_2} \int u_{L_2} dt, \\ U &= u_{L_2} + \frac{R_2}{L_2} \int u_{L_2} dt. \end{aligned}$$

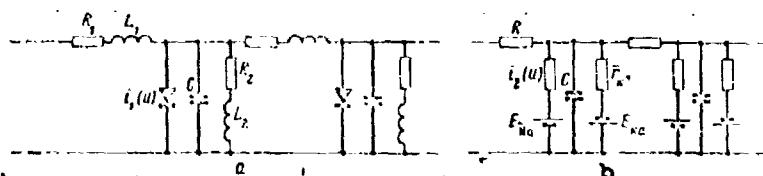


Fig. 1. Equivalent circuits: a - of pulse transmission line; b - of nerve-cell axon

where  $u_{L_2}$  is the voltage directly across  $L_2$ ; and  $i_1(u)$ ,  $C$ ,  $R_1$ ,  $R_2$ ,  $L_1$ ,  $L_2$  are the leakage current, the averaged junction capacitance of the distributed tunnel diode, series resistance, resistance in the bias circuit, series inductance, and inductance in the bias circuit. The line has purely distributed parameters, and the junction capacitance of the tunnel diodes is independent of voltage. The refractory period in the line and single- and multipulse cycles is examined. Results of experiments with a ring containing 40 cells with tunnel diodes are given, in which only single-pulse cycles could be observed, due to the short length of the ring. Orig. art. has: 12 formulas and 6 figures.

164.

AUTHOR: Gavronski, R.

ORG: none

TITLE: Some problems of simulating visual perception by neuron networks

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 124-125

TOPIC TAGS: visual perception, neuron, biologic model, information processing; mathematic analysis, form recognition

ABSTRACT: A general block diagram of the recognition process was developed based on electrophysiological data and certain clinical data connected with impairment of visual perception. The feasibility was demonstrated of simulating sequential stages of visual information processing in a model of a neuron network. Each processing stage was realized by complex networks with local connections based on the principles of generalization of lateral inhibition. Some principles for choice of weights of a connection were presented for selecting the outline and certain information areas of the form. The following stage of information processing was simulated by simple networks to determine proportions between signals. A body of signals which determine the characteristics of the forms was thus obtained. A method of mathematic description of complex networks was presented. The last stage of recognition can be simulated by a classifying device.

105.

AUTHOR: Gelig, A. Kh.

ORG: none

TITLE: Stability of neuron networks

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 29

TOPIC TAGS: neuron, mathematic model

ABSTRACT: Descriptions of networks in mathematic models of neurons with cross connections and feedbacks have two systems--a linear continuous system and a nonlinear impulse system. The first describes the dynamics of transitional processes within the neurons and their memories and the second describes frequency modulation of continuous signals produced within the neurons. Let us assume that at a certain moment the impulse arriving at the inputs of the network disappeared. If the transitional processes within the neurons of the network become stabilized within a certain time interval after this, and if the impulses at the outputs disappear, then such a network is called stable. Conditions guaranteeing the stability of neuron networks are described. These conditions are formulated as requirements imposed on the thresholds of the neurons and on the organization of connections between them and the properties of equations describing the internal dynamics of the neurons.

106.

AUTHORS: Gol'dshteyn, I. A.; Krayzmer, L. P.; Matyukhin, S. A.

ORG: none

TITLE: On the capacity of a neuron as a memory element of a high-reliability system

SOURCE: AN SSSR. Nauchnyy sovet po kompleksnoy probleme "Kibernetika". Voprosy bioniki (Problems of bionics) Moscow, Izd-vo "Nauka", 1967, 173-174

TOPIC TAGS: bionics, cybernetics, neuron, biologic model, human memory, reliability, dendrite

ABSTRACT: Soviet and Western literature on the capacity of a neuron as a memory element is reviewed. The authors consider probabilistic-statistic neuron coupling as the most probable mode. The Willis model of the plastic neuron is considered. That synaptic weights have varying values is seen to be fairly well confirmed experimentally. The authors find that there is not a one-to-one correspondence between the amount of information entering the brain and the amount stored. The human brain stores data in symbols and patterns rather than in bits. Orig. art. has: 2 formulas and 2 figures.

167.

AUTHORS: Gutchin, I. B.; Kuzichev, A. S.

ORG: none

TITLE: Synthesis of optimal formal neurons by means of analytic expressions using fibers of the "inhibit-inhibit" type

SOURCE: AN SSSR. Nauchnyy sovet po kompleksnoy probleme "Kibernetika". Voprosy bioniki (Problems of bionics) Moscow, Izd-vo "Nauka", 1967, 144-147

TOPIC TAGS: bionics, cybernetics, neuron, nerve cell, nerve fiber, analytic function

ABSTRACT: A new, simpler method of synthesis of formal neurons with analytic expressions is proposed, where the need for auxiliary threshold diagrams is eliminated. The analytic expression  $\Omega_n$  for a formal neuron  $A_n$  with  $n$  inputs  $a_1, \dots, a_n$  is a sum each of whose terms corresponds to only one of the branches of the neuron. A branch is a fiber that terminates in the neuron body. When  $n > 3$ , then

$$\begin{aligned}\Omega_3 = & H_1 a_1 + H_2 a_2 + H_3 a_3 + H_{1,2} a_1 (1 - a_2) + H_{1,3} a_1 (1 - a_3) + \\& + H_{2,1} a_2 (1 - a_1) + H_{2,3} a_2 (1 - a_3) + H_{3,1} a_3 (1 - a_1) + \\& + H_{2,1,2} a_2 (1 - a_1) (1 - a_2) + H_{1,2,3} a_1 (1 - a_2) (1 - a_3) + \\& + H_{2,1,3} a_2 (1 - a_1) (1 - a_3) + H_{3,1,2} a_3 (1 - a_1) (1 - a_2) + \\& + H_{1,2,3,1} a_1 (1 - a_2 (1 - a_3)) + H_{1,2,3,2} a_1 (1 - a_3 (1 - a_2)) + \\& + H_{2,1,3,2} a_2 (1 - a_1 (1 - a_3)) + H_{2,3,1,2} a_2 (1 - a_3 (1 - a_1)) + \\& + H_{3,1,2,1} a_3 (1 - a_1 (1 - a_2)) + H_{2,1,2,3} a_3 (1 - a_2 (1 - a_1)).\end{aligned}$$

The use of "inhibit-inhibit" fibers, where an inhibiting fiber terminates in another inhibiting fiber, reduces the minimum number of fibers required (see Fig. 1).

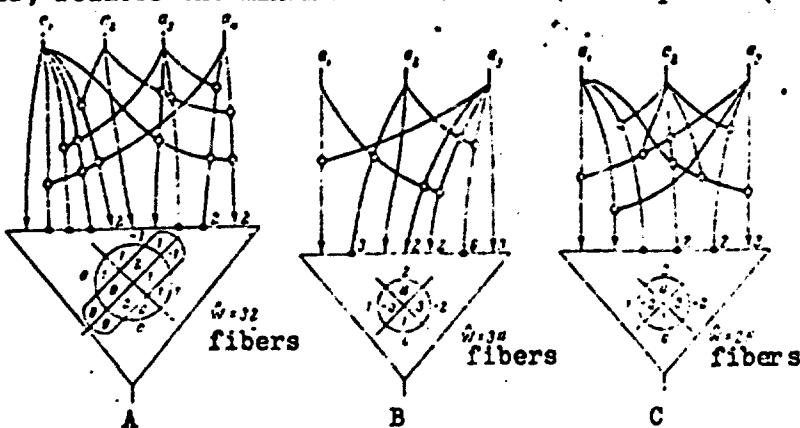


Fig. 1. Formal neuron with minimum number of fibers: A - example 1; B - example 2 without "inhibit-inhibit" fibers; C - example 2 with "inhibit-inhibit" fibers

Orig. art. has: 5 formulas and 1 figure.

168.

AUTHOR: Idel's, L. V.; Kruglikov, I. T.

ORG: none

TITLE: A model of synaptic transmission

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1957. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1957, 54-55

TOPIC TAGS: mathematic model, neuron, signal transmission, bioelectric phenomenon

ABSTRACT: Processes taking place in the synaptic plaque and in the synaptic fissure during passage of a complex afferent signal were analyzed with a mathematic model, taking into account the following properties of the system: 1) a certain quantity of transmitter (mediator) capable of release is contained in the synaptic plaque; 2) the nerve impulse induces release of a certain portion of the transmitter from the synaptic plaque into the synaptic fissure; 3) renewal of the initial quantity of chemical transmitter in the synaptic fissure takes place during a certain period of time which depends on previous activity; 4) the liberated transmitter diffuses through the synaptic fissure to the chemoreceptive membrane of the postsynaptic neuron, and at the same time there is a decrease in the quantity of transmitter because of breakdown and lateral diffusion (this is caused by the presence of a certain life of the transmitter); and, 5) the membrane potential of the presynaptic fiber and the initial quantity of transmitter capable of release are considered as constants. Origin from the synaptic plaque of a complex afferent signal with specific parameters is accompanied by amplitude distortions. Correction of these distortions can be accomplished both in the synaptic plaque itself and in the synaptic fissure. With low frequencies of impulse sequences in the afferent signal, correction is provided only by acceleration of reparation processes in the synaptic plaque. With higher frequencies it is provided by superposition of individual portions of the transmitter in the synaptic fissure. A relationship was found between parameters of input and output signals and the properties of the transmitting system. Some cases of change in individual parameters of the system in the process of transmitting a complex signal were examined. Calculated data were extremely close to experimental data.

169.

AUTHOR: Idel's, L. V.; Kruglikov, I. T.; Motsnyy, P. Ye.

ORG: none

TITLE: Regulation of the signal in active and passive elements of a homogeneous afferent structure

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 55

TOPIC TAGS: cat, bioelectric phenomenon, mathematic model, neuron, signal transmission

ABSTRACT: Processes developing in active and passive elements of an activated system in relation to strength of conditioning and test afferent signals were investigated in experiments on cats, based on changes in the first component of the potential of the dorsal surface of the spinal cord induced by stimulation of a cutaneous nerve. A mathematic model was constructed of processes taking place in active and passive elements of this homogeneous afferent structure during the passage of a complex signal. When the parameters of the system have a specific ratio to the quantity of activated and passive elements in it, either constriction or expansion of the transmitting channel can occur. When a weak signal activates a small number of the elements, constriction of the transmitting channel occurs due to the relatively large limitation of the following impulse in previously nonfunctioning elements compared to the limitations of the activated ones, i.e. a pulse even stronger than the previous one is transmitted in basically the same channel as the first one. With strong signals activating a large part of the system, the opposite effect is observed. The subsequent pulses are transmitted with less limitation along previously unactivated routes, i.e. expansion in a certain kind of transmitting channel and switching of pathways inside it take place. The relationship of the effects observed to the correlation of levels of external and internal noise in the system and of change in the latter during depolarization of terminal bifurcations of the primary afferents were investigated. Some hypotheses were expressed about the physiological purpose of the mechanisms examined for regulation of the transmission of afferent effects.

170.

AUTHOR: Ivanov-Muromskiy, K. A.; Paramonov, Yu. V.

ORG: none

TITLE: Prospects for the creation of neuro-technological systems

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referat, dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 53

TOPIC TAGS: neuron, bioelectric phenomenon, bionics

ABSTRACT: The feasibility of constructing systems combining neuron structures of living organisms with technological devices is considered. The electric activity of nerve formations is examined as input signals for technological systems. Possible variations in the creation of such systems are proposed.

171.

AUTHORS: Kirvelis, D. I.; Pozin, N. V.

ORG: none

TITLE: Some aspects of neuron logic

SOURCE: AN SSSR. Nauchnyy sovet po kompleksnoy probleme "Kibernetika". Voprosy bioniki (Problems of bionics) Moscow, Izd-vo "Nauka", 1967, 163-173

TOPIC TAGS: bionics, cybernetics, mathematic logic, planar logic, logic circuit, binary logic, computer logic, neuron, biologic model, mathematic model, analog computer / EMU analog computer (U)

ABSTRACT: Representations of elementary operations and functions of neuron logic are systematized using geometric interpretation. The main functional element has a set of stimulating and inhibiting inputs with synaptic weight factors  $S_i$  ( $-\infty \leq S_i \leq \infty$ ) and one output. The input  $x$  and output  $y$  values vary within  $0 \leq x \leq 1$  and  $0 \leq y \leq 1$ . The resultant input action is  $\sum_{i=1}^n S_i x_i$ , in which the terms for the inhibition inputs are negative. Operations corresponding to those of two-valued logic are considered, as are operations with two variables. The functions considered include absolute value, maximum, minimum, and ideal congruence (see Fig. 1). Examples of complex functions

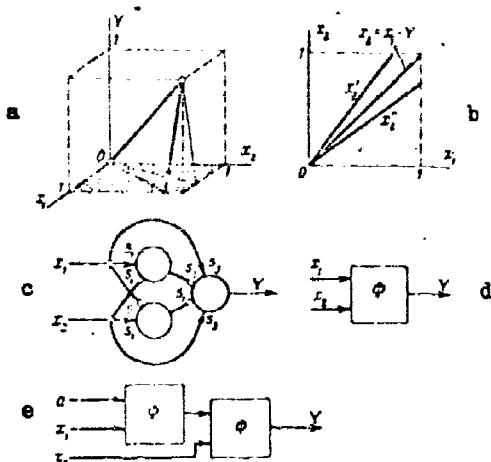


Fig. 1. Ideal congruence: a, b - geometric interpretation; c - neuron circuit; d - symbol; e - "strict ideal congruence"

are given, and the results of modeling with an EEU-8 analog computer are shown. Orig. art. has: 10 formulas, 10 figures, and 1 table.

172.

AUTHOR: Kogan, A. B.; Shcherbakova, G. V.; Chakhnakhyan, Ye. K.

ORG: none

**TITLE:** Materials for study of formation mechanisms of temporary connections in neuron networks

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don. Izd-vo Rostovskogo univ.. 1967. 66-67

**TOPIC TAGS:** neuron, biologic model, neurochemistry, bipotential

**ABSTRACT:** The performance of different transmitting functions of neuron networks requires their specific organization by distribution of impulse flows, achieved through processes similar to learning. Models of the physical and chemical bases of changes in the effectiveness of interneuron connections have been useful in the study of these processes. Local changes in intracellular structures and the dynamics of labile links of neuron metabolism (for example, ammonia formation) can serve as such models. The present experiments confirmed the metabolic basis of formation processes of new interneuron connections by determining the "chemical" value of their temperature coefficient. The neuron internal organization as a system and its role in the mechanism of interaction with other neurons in the nerve network are considered.

173.

AUTHCR: Kogan, A. B.; Sokolenko, P. T.; Samarin, A. I.

ORG: none

TITLE: Model of a multi-input neuron

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics): referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 67-68

TOPIC TAGS: neuron, biologic model, neurophysiology

ABSTRACT: Most neuron models in the literature are based on features of the work of a controlled generator of impulses. Structural features of the input, which determines the entire logic of the neuron's work, have scarcely been examined. Sufficiently effective means are lacking for the technical realization of multi-input neurons, and there are no models matching the real neuron with its multiple value functions. This is explained by the fact that there is enough physiological data on the properties of excited membranes to simulate them, but there is not enough information about other working elements of the neuron. The feasibility of constructing a neuron model whose properties approximate a real neuron was studied. Certain features of the design of the input of a neuron model were described based on known properties of mechanisms of synaptic interaction. Some of the assemblies of the model were constructed and investigated, and its use was considered for constructing sufficiently complex networks.

174.

AUTHOR: Kuznetsov, P. S.; Petunin, Yu. I.

ORG: none

TITLE: Random walk of an impulse in nerve networks with increase of conditional probability

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 78-79

TOPIC TAGS: neuron, random walk problem probability, mathematic model

ABSTRACT: Let  $n_{i,t}^l$  ( $i = 1, 2, \dots, m_l$ ) be the number of impulses conducted by neuron  $A_i$  through  $l$  synapse in moment of time  $t < t_0$ . A closed-loop nerve network  $S$  is examined which has the following property: the probability  $P_{ik}$  of passage of an impulse through neuron  $A_i$  to neuron  $A_k$ , which is synaptically connected with it, in a given moment of time  $t_0$  is a function of  $n_{i,t}^l$  ( $i = 1, 2, \dots, m_l$ ):

$$P_{ik} = P_{ik}(n_{1,t}^l, \dots, n_{m_l,t}^l).$$

With certain limitations of network  $S$  and of the function

$$P_{ik}(n_{1,t}^l, \dots, n_{m_l,t}^l)$$

during excitation of one of the neurons of network  $S$  with a probability equal to unity, the final paths of the random process which describes the impulse activity of the neurons prove to be cyclic. The results are applied to an investigation of neuron memory models.

175.

AUTHOR: Lobedov, A. N.; Lutskiy, V. A.

ORG: none

TITLE: Investigation of the instability of neuron characteristics and certain additional questions on the system's functional reliability

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 82-83

TOPIC TAGS: animal, neuron, biopotential, biological model

ABSTRACT: The neurons of vertebrate and invertebrate animals are distinguished by arrhythmicity of discharges under experimental conditions which approximate natural conditions. It has been proven that arrhythmic impulse flows of neurons are correlated. The correlation connection is expressed by the impulses being grouped in bundles and the impulse flows not being subject to Poisson's law. Periodic oscillations in the duration of interimpulse intervals in the neuron impulse flows make it possible to form a hypothesis about spontaneous oscillations of threshold characteristics of the neurons in the system. A model which simulates properties of the neurons of vertebrate and invertebrate animals is proposed for increasing the reliability of a technological system consisting of unreliable elements.

176.

TRANSITIONAL PROCESSES IN A MODEL OF A NEURON NETWORK WITH LATERAL COUPLINGS

ORG: Institute of Automation and Telemechanics (technical cybernetics),  
Academy of Sciences SSSR, Moscow (Institut avtomatiki i telemekhaniki  
(tekhnicheskoy kibernetiki) AN SSSR)

Lyubinskiy, I. A., and N. V. Pozin. Biofizika, v. 12, no. 2, 1967,  
272-276. AP7013909

The authors investigated the multilayer model of a neuron network. An analysis of transitional processes in this model with lateral couplings (combining excitatory and inhibitory influences) which served to accentuate stimulus input permitted the formulation of a number of behavioral characteristics of neurons in various levels of the model. These characteristics could be correlated with data from physiological experiments. For instance, during transition from a lower to a higher layer, there must be a tendency toward an increase in the percentage proportion of the number of neurons reacting to the initial ("on"-response) and terminal ("off"-response) action of the stimulus. The "tonic" or "phasic" response of a neuron determines its position relative to the greatest portion of the stimulus; neurons receiving the most stimulus operate "tonically." Altering the stimulus according to neuron layer (such as altering the audio frequency in an auditory system) results in a shift in the nature of neuron response from "tonic" to "phasic" or the opposite. UDC: 577.3 [CD]

177.

AUTHOR: Matyukhin, S. A.

ORG: none

TITLE: Effect of destruction of a neuron network on reaction time

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 92

TOPIC TAGS: neuron, brain, information processing, biologic model, digital computer, probability, random process

ABSTRACT: The time required by the brain for processing a given volume of information depends on a number of factors such as the level of the brain's tonic conditions. It is well known that destruction of an organic section of the brain decreases the speed of information processing. In a model of a nerve network which fulfills a memory function, removal of an arbitrary limited section of the network was simulated on a digital computer. It was demonstrated that with certain methods of organization in the network, phenomena such as change in reaction time of the system to an external stimulus can occur upon removal of part of the neurons. It was proven that the probability of an increase in the reaction time of the system is a random function of the size of the area removed.

178.

AUTHOR: Petrov, A. A.; P'yanzina, L. Ya.; Adzhimolayev, T. A.

ORG: none

TITLE: Problems of the theory of signal transformation in neuron networks

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo Univ., 1967, 113-114

TOPIC TAGS: mathematic model, neuron, biologic simulation, biopotential, signal transmission

ABSTRACT: Mathematic models are proposed of processes of receptor conversion of a continuous input signal into an impulse train and of the neuron transformation of impulse flows arriving through synaptic junctions. The following properties are supposed for the receptor neuron. The neuron is a threshold element which generates an impulse when the exciting influence reaches a specific threshold level. The role of neuron input impulses reduces to signal transmission according to the "yes-no" principle. Consequently it is not possible to take into account electrotonic changes in the neuron input potential. The internal state of the neuron, which depends on its previous functional history, also influences impulse generation. The form,

duration, and amplitude of the impulse do not carry information about the input influence, and the neuron impulse can be represented as a delta function. An exciting or inhibiting postsynaptic potential, which can be considered as the impulse characteristic of the signal, appears during passage of the delta pulse through the synaptic junction of the neuron. The synapses are linearly independent elements of the neuron. Analytic expressions were obtained linking the neuron impulsation frequency with neuron characteristics and with parameters of input influences.

179.

AUTHOR: Podkopyrov, A. I.

ORG: none

TITLE: Mathematic simulation of postsynaptic inhibition mechanisms

SOURCE: Vsesoyuznaya konferentsiya po neyrobernetike, 3d, Rostov-on-Don, 1967. Problemy nevrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 118

TOPIC TAGS: mathematic model, neuron, liopotential, second order differential equation, electrophysiology

ABSTRACT: A mathematic model was made based on data from electrophysiological investigations on the structural and functional neuron organization and the nature of the time lapse of postsynaptic inhibition (Eccles, 1957, 1964; Shapovalov, 1966; and others). Hyperpolarization of the postsynaptic membrane was described by a linear nonuniform second order differential equation with constant coefficients. The summation of inhibiting postsynaptic potentials, a steady state regime in the functioning of parameters and input information, and change in excitability of the postsynaptic membrane of a neuron during hyperpolarization were investigated. Differences in transitional states with various frequencies of repetition of inhibiting impulses were demonstrated. The model can be used to analyze interaction mechanisms of exciting and inhibiting influences and informational transformations of signals on the postsynaptic neuron membrane.

180.

AUTHOR: Popakov, V. I.

ORG: none

TITLE: Problems of the synthesis of optimal logical flexible networks in formal neurons

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 122-123

TOPIC TAGS: neuron, mathematic model

ABSTRACT: The coefficient of logical flexibility  $\gamma$  and the coefficient of logical stability  $\eta$  are used for qualitative evaluation of neuron networks. These coefficients are always found in a mutually single-valued correspondence. Consequently the equation  $\delta + \eta = 1$  can be written for any network. One reason for the high functional reliability of neuron networks is apparently the optimal or close to optimal combination of their logical flexibility and logical stability. The McCulloch (1962) networks of the second class of nonexpressed formal neurons were used in this work as models of neuron networks. For such networks

$$\gamma = \frac{m}{M} \text{ and } \eta = \frac{\theta - m}{\theta}$$

where  $m$  is the quantity of different output functions of the network in the interval of the useful range of change in threshold  $\theta$  and  $M$  is the maximum possible quantity of output functions of the network in the same range. The author explains a procedure of synthesis of optimal networks based on application of rank diagram graphs of neurons of the network and Maitre's stability charts. Formal transformations were presented which considerably reduce the number of operations during synthesis of different variations of the networks. Limits of logical flexibility for neuron networks with two variables were indicated.

175.

AUTHOR: Popov, I. V.

ORG: none

TITLE: Some properties of polysynaptic structures of nerve cells

SOURCE: Vsesoyuznaya konferentsiya po nayrokibernetike, 3d, Rostov-on-Don, 1967. Problemy nayrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 121-122

TOPIC TAGS: nerve cell, mathematic model, biopotential, probability, random process

ABSTRACT: A mathematic model of probability polysynaptic structures was made based on known data from electrophysiological, histochemical, and electron microscope investigations. The transformation of nerve impulse flows in the structures was analyzed by methods of the theory of random processes. Distribution functions for the probabilities of amplitudes of local postsynaptic potentials and of total postsynaptic potentials of the nerve cell were obtained for the case of Poisson input impulse flows. Synapses with chemical and electric transmission were examined. The relationship of statistical characteristics of the total postsynaptic potentials to the correlation of stimulating and inhibiting local postsynaptic potentials, and also to the "weight" of the synapses were investigated. Special attention was paid to examination of a mathematic model of presynaptic inhibition. It was concluded that: a) an individual synapse is an active transformer of information and realizes a probability connection between neurons; and, b) coding of information in polysynaptic structures is realized at the level of statistical characteristics of the states of these structures and of local and total postsynaptic potentials. These conclusions confirm the hypothesis of A. B. Kogan (1962) about the probability-statistic organization and functioning of neuron structures of the brain.

182.

AUTHOR: Posin, N. V.

ORG: none

TITLE: An hypothesis about a mechanism for search and marking of neuron network connections

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 118-119

TOPIC TAGS: neuron, biologic model

ABSTRACT: The author considered a hypothetical mechanism for search and marking of connections between two centers in a model of a uniform neuron layer using known information about neurons and neuron interactions. Search is begun after excitation of one of the input neurons of the given layer. Search is the process of finding among the output neurons a layer connected to an effector capable of compensating or eliminating influence from the external environment. After this is found search ends but the act of compensation itself continues until formation (marking) of a stable connection between sections which accept input (afferent) and give out output (efferent) signals. A case was examined where both parts of the process were accomplished on the same model of the neuron layer and the search mechanism was based on use of neuron switches. An hypothesis about increase in the strength (weight) of the connections between simultaneously excited neurons was developed as the basis of the marking mechanism.

183.

AUTHOR: Radchenko, A. N.

ORG: none

TITLE: Macromolecular mechanism for neuron stimulation and the memory

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 127-128

TOPIC TAGS: neuron, protein synthesis, biologic model, human memory

ABSTRACT: It is supposed that the neuron records by its stimulation each single act of protein synthesis. Conditions of protein synthesis in most active ribosomes are analytically recorded as functions of the stimulation of presynaptic fibers. The transmitting characteristics of the neuron are analyzed and a number of its properties are inferred, such as identification and decorrelation of signals, Dale's principle of the transition of stimulating synapses into inhibiting ones and vice versa, and the excess of inhibiting aftereffect over stimulating aftereffect. The author investigated change in transmitting characteristics of the neuron and neuron bundle in time due to the action of input signals. It was established that input information can be transmitted to the output without distortion of the impulse code time under only two of five possible conditions, of which the second condition is similar to the phenomenon of parabiosis. The remaining conditions distort the transmission of information through the neuron bundle and correspond to physiological inhibition. Upon closure of two neuron bundles of a ring, information storage was accomplished by calculation of not more than one-quarter of a bit per molecule. An electronic-optic model of a neuron ring with memory features was constructed.

184.

AUTHOR: Reznik, A. N. (Kiev)

ORG: none

TITLE: Statistic model of a plastic neuron

SOURCE: Mezhvuzovskaya nauchnaya konferentsiya po neyrokibernetike, 2d, Rostov-on-Don, 1965. Problemy neyrokibernetiki (Problems of neurocybernetics); materialy konferentsii, v. 2, Rostov-on-Don Izd-vo Rostovskogo univ., 1966, 198-203

TOPIC TAGS: neuron, statistic analysis, learning process, probability, signal detection, memory

ABSTRACT: To describe the work of a neuron statistically, it is assumed that the neuron performs the function of an optimal receiver separating some specific excitation (signal) from a background of other excitations arriving at its inputs (synapses) and acting as noise. Such an assumption makes it possible to utilize D. Middleton's (1952) theory of communication for determining the work of a neuron.

The neuron is considered a unit with  $n$  inputs at which excitation arrives described by  $n$ -dimensional vector  $U$  and with one output at which 0 or 1 appears with nondetection or detection of a signal respectively. The structure of an optimal receiver realized by the neuron is described by:

$$T_V(U) = \ln \frac{W(U|V)}{W(U)}, \quad (1)$$

where  $W(U|V)$  represents probability density of the appearance of excitation  $U$  with the condition that signal  $V$  is present; and  $W(U)$  represents unconditional probability density of the appearance of  $U$ . Any other function can be used instead of the logarithmic function in (1), but it has to be a monotone function.  $U$  is transformed in accordance with (1) and the result is compared with threshold value  $\beta$  whose valuation is selected to ensure the required probability of correct detection. The neuron output signal is described by:

$$Z_V(U) = \text{sign}[T_V(U) - \beta]. \quad (2)$$

To determine the form of operator  $T_V(U)$  it is necessary to know probability distribution densities  $W(U)$ . It has been found that the common property of statistically optimal receivers used as neuron models is the presence of a weighted summation of signals arriving at the different inputs and at different moments of time with a subsequent comparison of the sum with a certain threshold value. An important circumstance in the work of a neuron apparently is the presence of a certain dispersion (random or nonrandom) of the moment of appearance of signals (impulses) at the different neuron inputs. The influence of random dispersion may be eliminated with stretching of the impulses in time, while nonrandom dispersion requires the presence of a special transitional characteristic displaying peaks at the moments of expected appearance of signal impulses. Possibly, the numerous collaterals on the neuron axons serve the purpose of forming these complex transitional characteristics. On the basis of active learning of neuron models, a two part hypothesis is developed:

- 1) change of communication weight takes place only in the presence of a neuron response; and, 2) intensity of learning is proportional to the excitation value on the synaptic contacts of the neuron at the moment of response. Since the response of a neuron is always somewhat delayed in relation to the excitation, it must be assumed that synaptic contacts must have a certain memory whose mechanism may be easily connected with the time constant of acetylcholine breakdown in the synaptic fissures. The hypothesis of active learning also requires some minimal neuron activity for starting the learning process; and, requires spontaneous rhythmic neuron activity to ensure stochastic search of correct responses. Orig. art. has: 10 formulas.

105.

AUTHOR: Samarin, A. I. Sokolenko, P. T.

ORG: none

TITLE: Some properties of formal neuron networks

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 132-133

TOPIC TAGS: neuron, neurophysiology

ABSTRACT: One basic problem in investigating properties of formal neurons is the construction of reliable networks, i. e. networks in which the neuron thresholds can change independently within maximum limits while preserving the transmission function of the network. However, McCulloch (1966) considers that networks can be constructed which realize a greater quantity of functions with different values of neuron thresholds than with independent work of the same neurons. Such functional universality or flexibility also indicates the reliability of work of the neuron networks. It is possible that this property is inherent to a known degree even in the actual neuron structures. The authors presented certain types of "functionally flexible" but reliable neuron networks, evaluated the possible number of functions realized in relation to the number of inputs, made recommendations on the construction of such networks, and discussed their utilization.

186.

AUTHOR: Sergoyenko, N. D.; Chachanidze, N. I.

ORG: none

TITLE: Model of a neuron network with inhibiting connections

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 137-138

TOPIC TAGS: biologic model, neuron, nerve fiber, visual perception, form recognition, audition

ABSTRACT: The model of a multilayer network of formal neurons examined had the following features: 1) the network occurs in consequence of random branching of input and output fibers; 2) synapses of input fibers carry a stimulating signal and synapses of output fiber collaterals carry an inhibiting signal; and, 3) the effect of the signals on a selected neuron diminishes with the distance between it and the input or output fiber. Physiological premises for the network are considered and reaction of the network to signals of different form is examined. The following effects were explained based on the behavior of a given network: a) change in the dimensions of retinal receptive fields in relation to illumination; b) emphasizing of the contours of the image; and, c) accentuation of the resonance curve of the cochlea in the auditory analyzer system.

187.

AUTHOR: Shtark, N. B.; Murgelaytis, N. G.

ORG: none

TITLE: Physiological and morphochemical prerequisites for simulating the neuron organization of operational storage and memory consolidation

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 167-168

TOPIC TAGS: neuron, human memory, brain, biologic model, protein synthesis, dendrite, RNA

ABSTRACT: Construction of a theoretical and physical model of the neuron organization of operational memory based on the activity of the hippocampal neurons presumes calculation of the following morphochemical and physiological properties of these cellular elements: 1) presence of primary and secondary neuron contours composed of hippocampal neurons and pyramids, which cause both prolonged "reverberation" of the action potentials in closed-loop systems and a diversity of mechanisms for inhibiting the basic cellular elements under conditions of trace fixation; 2) presence of two maximums of the basic impulse activity, conditions of paired impulses and of high frequency bundle activity, considered as an external expression of automatic regulation of gradual depolarization of the membrane that forms the impulse flow within the limits of the "reverberation"; 3) considerable intensity of the protein restoration rate and a high level of RNA-dependent protein synthesis in the cytoplasm of the hippocampal neurons, which makes neuron activity highly efficient and makes it chemically possible to organize new synaptic areas for consolidation of memory and conversion of operational storage into large capacity storage; 4) existence of a network of basal and apical dendrites on which axons of cortical and subcortical neurons converge, which determines the coordinating possibilities of hippocampal cellular elements, the organization of recognition, and selection of the signal; 5) high sensitivity of postsynaptic electrogenesis to substances which block RNA-dependent protein synthesis, which is linked with the direct participation of RNA structures in regulation of the excitability of postsynaptic membranes to the chemical mediators of excitation; and, 6) presence of two "trigger" zones on the hippocampal pyramids which cause the appearance of reciprocal antagonism and synergism of neuron polar structures and enable active search for optimal conditions of activity of the pyramids.

188.

AUTHOR: Sokolov, Ye. N.; Fomin, S. V.

ORG: none

TITLE: Neuron mechanisms for signal discrimination

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo rostovskogo univ., 1967, 141-142

TOPIC TAGS: visual perception, neuron, biologic model, feedback, algorithm

ABSTRACT: The model presented is a multilayer system of formal neurons with lateral inhibiting connections. The connections between the layers are stimulating, and there is inhibiting feedback from the output of each layer either on the sensing layer or on the preceding layer. All connections are variable, and the algorithm for change in connections is defined by the concept of a neuron network with interacting automata which increase their functional value depending on input signals. As a result detectors (ensembles, coalitions) of neurons are formed similar to the detectors of characteristics found in the visual system. Inhibiting feedback achieves effective use of characteristics for discrimination by developing the most informative characteristics.

189.

#### A PHYSICAL MODEL OF NEURON EXCITATION

ORG: none

Tushenkov, L. I. AN UkrSSR. Modelirovaniye v biologii i meditsine (Modeling in biology and medicine), no. 2. Kiev, Naukova dumka, 1966, 85-90.  
AT7009689

The model represents a relaxation oscillator based on a MTKh-90 gas discharge tube with two R-C circuits (see Fig. 1). With a steady

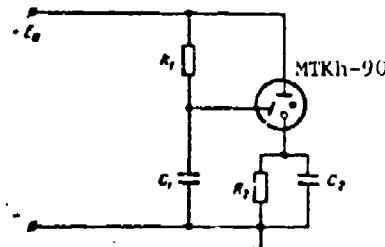


Fig. 1.

input signal the model displays a spontaneous rhythm. Space-time summation in the model is made possible by capacitor  $C_1$ . With the

use of a blocking capacitor and diodes, the model can operate in a circuit as an intermediate neuron. The physiological properties of neuron excitation are adequately reflected by the model. Model shortcomings include high anode voltage and distortion between input and amplitude.

UDC: none

[06]

190.

NEURON MECHANISM OF ORIENTATION REFLEXES AND TEMPORARY CONNECTIONS IN THE CEREBRAL CORTEX AND SOME PROBLEMS RELATED TO THEIR MODELING

ORG: Institute of Experimental Medicine, Academy of Medical Sciences SSSR,  
Leningrad

Vasilevskiy, N. N. Soveshchaniye po problemam vysshey nervnoy  
deyatelnosti, 21st, 1966, Tezisy i referaty dokladov, Moscow,  
Izd-vo "Nauka," 1966. 65.

AT7024082

In studying the neuron mechanisms of orientation and conditioned reflexes, the special characteristics of the afferent connections and adaptive properties of the separate neurons should be considered, and also the functional organization of the neuron systems of the separate analyzers. An analysis of the sizes, localization, and modality of the receptive fields and the latent periods of neuron reactions in the somato-sensory cortex area of rabbits show that two basic types of neurons can be identified: neurons with local receptive fields and neurons with wide-spread receptive fields. Neurons of the first type display the most stable reactions with repeated application of stimuli and development of temporary connections, and neurons of the second type display an expressed plasticity of reactions. Study data on the functional system of cortex projection zones provide the basis for a cybernetic model of a perceptron. The paper considers the present state of the theory of organizing adaptive networks from plastic neurons as a basis for modeling conditioned and orientation reflexes.

[06]

191.

AUTHOR: Vishnevskiy, A. P.

ORG: none

TITLE: A single concept of neuron simulation

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 23-24

TOPIC TAGS: biologic model, neuron, mathematic model

ABSTRACT: In simulating neurons in neurocybernetics and bionics, physiologists and engineers pursue the aim of clarifying and refining the operational principle of the real neuron, its structure, its physical, chemical, and electrical characteristics, and its capacity to interact with other neurons. It is important to study the capacity for reducing information flow, that is, finding the characteristics of the operations related to impulse sequences reaching the synapses. An informal model of a neuron is presented as a polylogical element which is described mathematically. As a result of investigating the model, hypotheses are proposed concerning the functioning and structure of a real neuron.

## SECTION C. PROBLEMS OF MODELLING HIGHER NERVOUS ACTIVITY

192.

### FEASIBILITY AND OUTLOOK FOR MODELING PSYCHIC FUNCTIONS

ORG: none

N. M. Amosov. AN UkrSSR. Modelirovaniye v biologii i meditsine  
(Modeling in biology and medicine). no. 2. Kiev, Naukova dumka, 1966,  
6-12. AP7009683

The human brain is a complex information-processing system capable of perceiving external actions, separating the information, processing the information, and then acting on the external medium. At the same time three types of programs interact: self-preservation, perpetuation of the race, and socially acceptable behavior. Information processing operates on three levels with instincts on the lowest level, acquired learning on the next level, and abstract thinking and creativity on the highest level. For purposes of modeling, psychic functions can be regarded as information. Different psychic programs are considered, including feelings, consciousness and subconsciousness, and creativity. With the development of more sophisticated digital computers capable of carrying out varied and complex programs, the modeling of psychic functions appears feasible. The algorithm for a structural model of psychic functions can be represented as follows. First, a structural plan is drawn up showing the models and their circuits, and a code system is devised. Each model is assigned a number and a place in the memory. The "activity" (energy) level of each model and the number characteristic by which it changes in time upon receiving a certain energy level from other models are designated in the memory. Circuits are formed between the models, with the number of circuits dependent on the complexity of the modeled function. Despite the many limitations of computers, modeling should be based on these machines until improved systems are developed. UDC: none [06]

express only a "generalized" model--they are suitable only for describing the steady-state mode of operation of a system or of its small variations. However, all complex systems are dynamic systems; therefore, for their design, dynamic characteristics must be used. Dynamic characteristics are expressed by the systems of differential equations. However, for calculating complex systems, differential equations cannot be used and simplified methods must be utilized. Explanation is given of how "dynamic characteristics of the first and second orders" can be described. For the dynamic characteristics of the second order, the concepts of memory and adaptation are introduced and their various forms are analyzed in connection with biological processes. Only the most simple types of dynamic characteristics, when the transient regime is described by linear or linearized function, were considered. It is stressed that very often an oscillatory transient regime takes place. However, in modeling it is impossible to consider the dynamic oscillatory characteristics of elements. Section 4 deals with pathological characteristics which always are considered as dynamic. All living organisms (systems) not only become ill, but also recover, i.e., the normal parameters are restored. Four parameters of restoration processes are considered. It is pointed out that in a "pathological" regime processes are acting simultaneously to increase the deviation from the normal state, as well as the opposite—protective processes. The general variation trend of a system is determined by the quantitative ratio of these two types of processes. Section 5 analyzes the models of the control system in living organisms. The principal peculiarity of control elements or their combinations is their ability not only to respond to several stimuli (inputs), but also to give an answer to certain information contained in the input. How this particular information can be singled out is described. It is pointed out that for control systems, the second order dynamic characteristics are of a great importance. Section 6 deals with calculation of two types of models: 1) Calculation of a stationary or of a slowly varying regime; and 2) Calculation of a dynamic regime. It is indicated that calculation of stationary regimes is reduced to the solution of a system of algebraic equations which can be approximately solved by computers. The calculation of a dynamic regime is more complicated. The calculation procedures for both cases are described and similarities and differences between the two calculation procedures are investigated. Orig. art. has: 15 figures and 3 tables.

[WA-108] [LK]

193.

AUTHOR: Amosov, N. N. (Professor, Scientific director of the seminar,  
Corresponding member AMN SSSR) (Kiev)

ORG: none

TITLE: A method for modeling complex systems

SOURCE: Seminar "Nekotoryye problemy biokibernetiki i primeneniye  
elektroniki v biologii i meditsine", Doklady, no. 2, 1967, 3-40

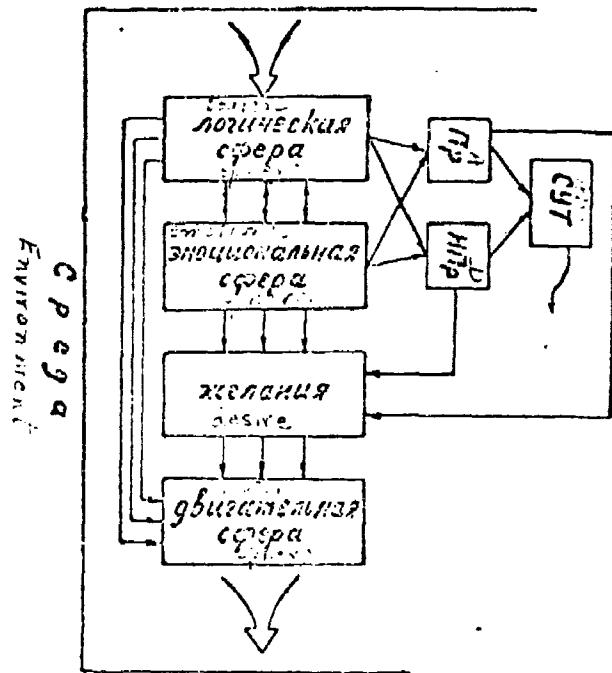
TOPIC TAGS: model theory, dynamic system, complex system modeling

ABSTRACT: This article is a review dealing with modeling of complex systems. The problem of establishing an "operational model" of a complex system is reduced to the calculation of changes taking place in time in functions of their most important elements. To carry out these calculations the following sequence of operations is considered: a) to construct the block diagram of a system; b) to formulate or to determine the characteristics of elements by selecting time characteristics, input and output parameters, and their boundary conditions; c) to set up the initial state of a system (of its elements); d) to set or to determine the values and points of applications of external responses and also their sequence in time; e) to carry out calculations properly. The article is divided into six sections corresponding to these operations. Section 1 deals with the structure of a system. It is indicated that every scientist dealing with the modeling of complex systems has to decompose the system into such number of subsystems as would reflect the most important functions of the system and, at the same time, would be accessible to calculations. Therefore, it is necessary to select the minimal necessary number of elements by means of which the unknown function can be obtained. In a structural scheme two levels are distinguished: lower (operational) and higher (controlling). The number of elements and connections can be constant (rigid schemes) or variable (flexible schemes). Section 2 analyzes the problem of defining or determining the characteristics of elements of the system such as real-time operation, and selection of input and output parameters, their dimensions, and boundary conditions. These characteristics are established on the basis of hypotheses which exist in the scientist's mind concerning the logic relations between the elements of the system. Section 3 studies the static and dynamic characteristics of elements or subsystems of a system. It is pointed out that static characteristics can be expressed by means of formulas, graphs, or tables. It is advised that these characteristics should be expressed in the simplest forms possible. Static characteristics

emotional stage is changed so the course of the system disrupts the developed plan, special emergency programs are switched in to correct or reorganize the plan. Programs of the described system approximately model certain programs of higher animal and human psyches. Orig. art. has: 4 figures.

**NOT REPRODUCIBLE**

Fig. 2. Diagram of the interaction of the elements of the system.



194.

AUTHOR: Amosov, N. N.; Kasatkin, A. N.; Kasatkina, L. N.

ORG: Cybernetics Institute AN USSR (In-t kibernetiki AN USSR)

TITLE: An heuristic model of behavior

SOURCE: Mezhvuzovskaya nauchnaya konferentsiya po neyrokibernetike, 2d, Rostov-on-Don, 1965. Problemy neyrokibernetiki (Problems of neurocybernetics); materialy konferentsii, v. 2, Rostov-on-Don, Izd-vo Rostovskogo univ., 1966, 219-226

TOPIC TAGS: cybernetics, behavior pattern, model, biologic model, brain, human, animal

ABSTRACT: The method of heuristic modeling is applied in studying the human brain. The system structure is simulated by a black box whose input is information about the system's environs (associations of cubicles or cells which contain, at random, objects which are positive or negative stimuli of different intensity for the system), and output is a signal which may be considered the system's reaction to a given situation. The structure of the system is a multistage organization of a plurality of elements--models; each model corresponds to, and is activated by specific code generated from information entering the system input. The models have connections whose passability depends on frequency of use and time. Information analysis in the system is simulated in the logical, emotional, and motor spheres. Models of the first stage correspond to external objects and are activated when the system "sees" the objects; models of the second stage are collections of models of the first stage models; models of the third stage are collections of the second stage models. Associative bonds exist between the models of each stage. An amplifier-decelerator system (ADS) directs the course of the information analysis processes by putting out the most important information at each time instant and amplifying activation of the corresponding models. In the diagram showing the interaction of the structural elements (Fig. 2), the external environment activates models in the first stage of the logic sphere and models of concrete sensations (hunger, fatigue) in the first stage of the emotional sphere. The sensation models are connected to corresponding desire models. The system has centers for evaluating "agreeable" ( $\lambda$ ) and "disagreeable" ( $\mu$ ) conditions; activation of these centers affects operation of the ADS and activation of the desire models. If the ADS system connects element action of the first stage of the motor sphere to the model, a special program is engaged which transfers the system from one cell area to another. Processes in the logical and emotional spheres effect selection of this elementary action. On searching part of the area, the system assigns to the models of each cell a given activation potential-- a hyperplane of potentials is formed for each stage of the model area. Procedural plan is formed, taking into account the hyperplane selection method (the system is transferred to the cell with the highest potential). The system starts, controlled by the effects of processes in the logical and emotional spheres and by the developed procedural plan. If the state of the

195.

AUTHOR: Antonov, Yu. G.

ORG: Institute of Cybernetics AN USSR (In-t kibernetiki AN USSR)

TITLE: Indeterminism and determinism in the activity of cortical analyzers

SOURCE: Nezhvuzovskaya nauchnaya konferentsiya po neyrokibernetike, 2d, Rostov-on-Don, 1956. Problemy neyrokibernetiki (Problems of neurocybernetics); materialy konferentsii, v. 2, Rostov-on-Don, Izd-vo Rostovskogo univ., 1956, 15-25

TOPIC TAGS: learning process, biologic model, brain, neuron, human, memory, training, neurophysiology, cybernetics

ABSTRACT: Investigators have considered the brain a collection of trigger-decision elements. Three hypotheses, each in agreement with electro-physiological and histological data, are discussed. The possibility is examined of the formation, in the brain structure during the training process, of determinative elements and of acquisition of a new quality in a local section of the neuron network. The complexity of the diversity of the neuron network is considered a characteristic of this new quality, manifested electrophysiologically by continuous rhythm circulating in a given neuron mass. The complexity of certain neuron networks was evaluated, assuming that the threshold of each neuron is constant, that there are no axoaxonal synapses, and that the total axosomatic synapses equal unity. The maximum diversity in a network containing stimulating and inhibiting connections between the neurons  $n$  is  $M_{\text{max}} = 2 \times n^2$ . If the neuron network is to attain the new quality the diversity must exceed a critical value  $M_{\text{crit}}$  for the given network. A model study to determine the minimum number of network neurons and minimum number of connections between them necessary for establishing circulating rhythm in the system after removal of external stimulus showed that in four-neuron network  $M_{\text{crit}} = 8$  (while  $M_{\text{max}} = 12$ ). Oscillograms of neuron output potentials confirmed circulating rhythm was maintained without external stimulus, and showed that application of a constant superthreshold caused loss of regularity in the discharge of the third and fourth neurons. Cause for this irregularity is discussed. Increasing the diversity to  $M = 11$  has a stabilizing effect on the rhythm circulation when any input is stimulated. Thus the critical level of network complexity is a definite zone of indeterminism through which the neuron network passes in switching from one determined state to the second. This zone depends on the parameters of the network elements (neuron thresholds) and on the total combinations (synapses). This property is apparently necessary for the formation of circulating memory units and determinative trigger elements of the brain. Dynamics of changes in a neuron network in retraining, exemplified by retraining a nocturnal animal to sleeping at night, are discussed; uncertainty proceeds from zero at the start of the retraining, through a maximum when the probabilities are equal, back to zero at the end of the period. The more complex case--training of a biological system by the action of the environment, is discussed, briefly. It is concluded that both the elements of the cortical analyzers (simple neuron blocks) and the analyzer itself pass from one determinism to the other through a zone of indeterminism. Orig. art. has: 6 formulas and 3 figures.

196.

AUTHOR: Avramkov, D. V.

ORG: none

TITLE: Structure of purposeful activity and heuristic programs of behavior

SCIF.CS: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967.  
Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov  
konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 3

TOPIC TAGS: cybernetics, computer programming

ABSTRACT: From the viewpoint of the general theory of solving problems on which modern programming is based, the process of problem solution is a sequence or a system of operations, but the state of the object of transformation and the set of operators are two classes of problem description. This is true of both heuristic and nonheuristic programming. Heuristic and nonheuristic programming differ in the conditions under which the programming is done. However, contrasting heuristic and nonheuristic programs and attempting to present the former as programs of a special kind, qualitatively different from the latter, is inadmissible. The structure of heuristic programs and their implementation in computers demonstrates their qualitative similarity to all other programs. Heuristic programs must at least provide the computer with the possibility of conducting experiments with objects of the external environment. In heuristic programming, in addition to using objects of transformation and a set of operators, it is also necessary to introduce a subject of activity, problem or purpose. In so doing, if in the works of Newell and others we understand purpose as the finite area of the labyrinth and means as the required operator, then in a given case the concepts of purpose and their means take on another, broader meaning. Utilization of these concepts will substantially expand possibilities for heuristic programming.

197.

BRAIN MECHANISMS AND SPATIAL ANALYSIS

Ayrapet'yants, E. Sh. AN SSSR. Ob'yedinenny nauchny sovet "Fiziologiya cheloveka i zhivotnykh." Issledovaniye apparatov signalizatsii mozga (Study of the signalization apparatus of the brain). Leningrad, Izd-vo "Nauka," 1967, 11-21. AT7025928

Roles of the analyzer systems and paired functions of the cerebral hemispheres in spatial analysis are discussed. A hypothesis is advanced that in the evolutionary process the division of the forebrain and its development into hemispheres is the result of progressive cephalization of the higher nervous mechanisms related to the broadening of the range and level of space analysis. The multicomponent mobile structure of the complex spatial analysis apparatus is based on integration of inter-analyzer functions and symmetrically paired functions. The reliability of this system is developed on the principle of substitution of physiological functions and morphological structures. A sharp restriction of afferent channels or removal of a considerable part of the brain does not produce a critical deficit of information or irreversible disorders of integration. The principle of substitution is found on all levels of nervous organization. Optimally the system of substitution is developed at the cortical level. Thus, brain evolution also reflects the evolution of the substitution principle by broadening the redundancy of the particular mechanisms. Neuron dynamism displays itself under conditions of brain damage as well as in normal activity by ensuring the most efficient interconnection of analyzers in the realization of behavioral acts involving spatial relationships. The article represents an expansion of a report presented by the author at the XXIII International Congress of Physiological Sciences in Tokyo on 3 September 1965.

UDC: 612.325.5:153.71+612.325.4

[06]

198.

AUTHOR: Bereznaya, I. Ya.; Granovskaya, R. M.

CGR: none

TITLE: Memory model based on elements similar to neurons

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 11-12

TOPIC TAGS: neuron, human memory, biologic model

ABSTRACT: The simplest such memory model, using logic elements with and without memory, is examined. Selection of logic elements depends on the type of conversion of impulse information by individual types of visual neurons--on, off, and on-off. Open and closed linear series circuits of these elements are used as the basic structure. Binary cyclical  $n$ -digital codes are used for input information. It was demonstrated that such a memory model permits storing different volumes of information under different conditions, static or dynamic, depending on the elements, with or without memory, of which the circuit is constructed. Also examined are methods of decoding input codes according to static information a certain time after cessation of their appearance at the circuit input.

199.

AUTHOR: Bianki, V. L.; Polonnikov, R. I.

CGR: none

TITLE: The principle of pairing in the functioning of the brain and automatic systems

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 13

TOPIC TAGS: brain, automatic control system

ABSTRACT: The significance of the pairing function of the large hemispheres of the brain for normal realization of spatial analysis, for transfer of information from one side of the brain to the other, and for sustaining high excitability of the cortex, etc. has been established in numerous physiological investigations. It has been demonstrated that surgical separation of the hemispheres disrupts an animal's ability to differentiate location, geometric form, and movement of stimuli. On the basis of experimental data a thesis is formulated on the comparative function of the hemispheres in the process of spatial analysis. A substantial role in the activity of this comparator is played by the physiological dominance which is formed in the hemisphere

opposite the location of the stimulation source, and which conjointly inhibits the ipsilateral hemisphere. Analysis of engineering systems indicated a class of automatic systems constructed according to the pairing principle. Specific assemblies of these systems can be considered as analogs of nerve centers. Synthesis of cross connections between them was accomplished with a matrix. Comparative analysis of automatic systems and of systems with connections simulating the neural mechanism of reciprocal interrelationships was carried out. The advantage of a system with connections was demonstrated. An attempt was made to simulate dominant interhemisphere interactions.

200.

AUTHOR: Biryukov, B. V.; Geller, Ye. S.

ORG: None

TITLE: Modeling and neurocybernetics

SOURCE: Priroda, no. 4, 1967, 42-46

TOPIC TAGS: scientific research, scientific conference, neurocybernetics, neurophysiology, brain, mathematics, information theory, game theory, mathematic model

ABSTRACT: Developments in the field of neurocybernetics, the result of the penetration of cybernetics into the research on higher nervous activity and neurophysiology, as well as the connection with mathematics, information theory, game theory, logic, etc., are described. The manner in which modeling is used as the basis for the study is discussed. The work done by a symposium on neurocybernetics, held in Dubno, USSR, in August 1966, is noted, and the model of the brain developed by P. K. Anokhin is detailed. The work done by philosophers B. A. Glinsky and A. Ya. Il'in in equating modeling to definite stages in the development of the natural sciences, and by A. M. Karpukhin in connection with the mechanism of the respiratory system, is mentioned. The variety of models which can be used in neurocybernetics in moving along the path to making neurocybernetics an exact science is detailed, and the conclusion is drawn that it will take the close cooperation of physiologists, mathematicians, and engineers to arrive at real success in probing the secrets of the brain. Orig. art. has: 2 figures.

201.

AUTHORS: Blank, A. M.; Ryabikin, A. I.; Ryabokon', V. P.

ORG: none

TITLE: On the experimental study of algorithms "behavior"

SOURCE: AN SSSR. Nauchnyy sovet po kompleksnoy probleme "Kibernetika". Voprosy bioniki (Problems of bionics) Moscow, Izd-vo "Nauka", 1967, 266-272

TOPIC TAGS: bionics, cybernetics, algorithm, automation, programmed teaching, teaching machine, teaching theory, sequence, learning theory, programmed learning

ABSTRACT: A model of the behavior of a subject in an experiment is examined. The algorithm is approximately described by the sequence of all measurements of the experiment:

$$K_1, K_{i_2}, \dots, K_{i_n} | K_1, K_{i_2}, \dots, K_{i_n} | \dots | K_1, K_{i_2}, \dots, K_{i_n}, \dots$$

Measurement  $K_{i_1}$  does not permit one point to be excluded from the initial set. Each of the measurements  $K_{1i_1}, K_{2i_2}, \dots, K_{ni_n}$  permits exclusion of more than one point from the set containing  $K_S$ . Each of the remaining measurements permits not more than one point to be excluded. A numeric example is given for illustration. Experiments with student-subjects showed that membership of a student's diagram in a definite category was a characteristic of his preparedness to solve a given problem. Orig. art. has: 3 formulas, 3 figures, and 1 table.

202.

AUTHOR: Blazhkin, K. A.

ORG: none

TITLE: On the relationship of learning processes in self-organizing systems with iterative methods of solving equations

SOURCE: AN SSSR. Nauchnyy sovet po kompleksnoy probleme "Kibernetika". Voprosy bioniki (Problems of bionics) Moscow, Izd-vo "Nauka", 1967, 280-284

TOPIC TAGS: bionics, cybernetics, biologic model, mathematic model, self organizing system, learning mechanism, learning theory, perceptron

ABSTRACT: The various points of view of the problem of learning are surveyed briefly, and the perceptron model of F. Rozenblatt (see Fig. 1) is examined in detail. The learning algorithm comes down to reinforcing (changing the weights of) all neuron-associators that are excited when a given situation appears at the input in the case

of an incorrect reaction. Transformation of the perceptron to a system of inequalities is discussed. The described model is considered sufficiently efficient when the existing theories are borne in mind.

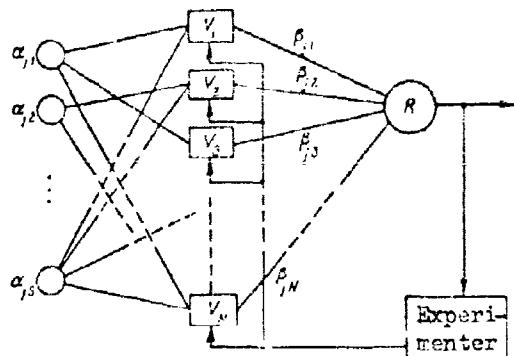


Fig. 1. Perceptron

Orig. art. has: 2 formulas and 2 figures.

203.

AUTHOR: Borisov, V. I.

ORG: none

TITLE: The problem of information storage methods

SOURCE: Vsesoyuznaya konferentsiya po neirokibernetike, 3d, Rostov-on-Don, 1967. Problemy neirokibernetiki (Problems of neural cybernetics), materialy dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 109

TOPIC TAGS: human memory, computer memory, memory element, biologic model, computer simulation

ABSTRACT: A short analysis of possible methods for constructing devices which imitate memory was given. The possibility of increasing memory capacity by multiple use of elements and questions of optimal coding and reliability were examined. A rough calculation was made of the increase in memory capacity resulting from an increase in number of elements.

204.

AUTHOR: A.N. Slobodcikov, N. V. Kozhevnikov, et al.

ORG: none

TITLE: Study of the problem of model simulation of probabilistic and uniquely determined sequences of reinforcement

SOURCES: A.N. Slobodcikov. Sovet po kompleksnoy probleme "Kibernetika." Voprosy Bioniki (Problems of bionics) no. 6, issn-ve "Mnem.," 1967, 237-251

TOPIC TAGS: cybernetics, bionics, probability, learning theory, teaching theory, teaching machine

ABSTRACT: The ability of man to predict the appearance of probabilistic and uniquely determined events is studied. The hypothesis of formation in the central nervous system of a statistic model of the external medium permitting extrapolation of events and responses on the basis of accumulated experience is used. University students were given the problem of choosing between two actions each of which had a determined independent probability of reinforcement. In the experiments with mastering probabilistic programs, the subjects could determine differences in probabilities of reinforcement with accuracy to 0.1. This ability is found to depend not on the probability ratio but rather on the probability difference. The effect of the absence of reinforcement on the probability of response is also examined. Studies confirmed the possibility of using models of relative certainty and relative probability to describe learning. Orig. art. has: 2 tables and 2 figures.

205.

AUTHOR: Budashevskiy, V. G.; Orlov, V. A.

ORG: none

TITLE: Development of an algorithm simulating probability learning

SOURCES: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 15-16

TOPIC TAGS: algorithm, mathematic model, learning mechanism, probability

ABSTRACT: Development of a probability learning model is presented based on analysis of experimental data. Experimental methods for probability learning and a plan for construction of a mathematic model of optimal behavior with a choice of two actions were explained earlier (Budashevskiy and Minitskiy, 1965; Budashevskiy, 1966). That model was made on a digital electronic computer, and its behavior corresponded to experimental data. Construction of an algorithm of behavior with a choice of four actions was the next step in developing the model. The algorithm can be utilized with simulation of "behavior with a choice" from an unlimited number of actions. A number of shortcomings in the earlier model have been eliminated, particularly its inertness, i.e. its inability to relearn rapidly with change in the probability "external environment." Agreement between the quantitative characteristics of behavior obtained experimentally and in the model is discussed.

200.

AUTHOR: Bundayev, P. V.; Menitskiy, S. N.; Chubarov, A. V.

C.G: none

TITLE: Electrophysiological investigation and simulation of "orientation" and conditioned reflex mechanisms for self-regulation of the functional state of the brain

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov.-on-Don, Izd-vo Rostovskogo univ., 1967, 16

TOPIC TAGS: EEG, conditioned reflex, biologic model, brain, self regulation, parameter

ABSTRACT: This investigation was carried out to substantiate one of the possible principles of coordination in the nervous system -- the principle of "optimal interaction of nerve centers," which postulates the necessity for correcting influences when there is either an excess or an insufficiency of input afference (Menitskiy, 1964). It was also demonstrated that the functional state of the central nervous system depends on the statistical structure of the external environment; and, that the dynamics of the conditioned reflex reactions reflect changes in correlations (regularities) and redundancies of the stimuli system, but the orientation reactions are proportional to the value of entropy (or of useful information). The electroencephalographic method used in the work had automatic photostimulation controlled according to the feedback principle under pulse and sinusoidal conditions (Bundayev, Menitskiy, 1964, 1965, 1966) and had brightness modulated directly by EEG oscillations. Simulation of the hierarchical construction of this complex dynamic system and of the intercorrelation of its parameters in the process of self-regulation led to the conclusion that a multiparametric system of external feedback is necessary for studying the controlling mechanisms of the brain.

207.

AUTHOR: Bushara, I. V.

ORG: none

TITLE: Problems of heuristics in form recognition

SOURCE: AN SSSR. Nauchnyy sovet po kompleksnoy probleme "Kibernetika". Voprosy bioniki (Problems of Bionics) Moscow, Izd-vo "Nauka", 1967, 272-276

TOPIC TAGS: form recognition, artificial intelligence heuristics, computer language, information processing

ABSTRACT: Current trends in heuristics are outlined, defining this science as an outgrowth of cybernetics and psychology which deals with the improvement of solutions of their problems and seeks eventually to create an artificial brain. Among the approaches to the artificial brain problem mentioned are an heuristic programming theory suggested by Newell, Shaw, and Simon in 1957 and 1959, and a theory considering the human brain to be a system of information processing operators. Also mentioned briefly are motion picture studies of the brain activity of chess players, reflected by the motion of their eyes and hands, conducted at the Moscow University psychological laboratories and indicating that a chess player's prognosis is a kind of heuristic device. The other Soviet heuristics studies reviewed include form recognition programs proposed by various authors in order to translate human heuristics into computer language, and studies of Minskiy, reviewed in more detail, who divides heuristic computer programming procedure into search, recognition, instruction, planning, and induction, and considers the development of an adequate system of characteristics of a plant and effective planning to be most essential for the reduction of the scope of search in heuristic programming. He believes further that model-based planning is a productive approach to the reduction of searching procedures, and that the construction of a computer which would find for itself an appropriate planning method is realizable.

208.

AUTHOR: Chavchenidze, V. V.; Beronikashvili, N. N.; Chumburdze, M. A.; Nutsubidze, M. A.; Nikashavidze, G. N.

ORG: none

TITLE: Simulation of special brain functions by networks of formal neurons with many inputs

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 159

TOPIC TAGS: brain, neuron, human memory, conditioned reflex, mathematic model

ABSTRACT: Examination of pyramidal constricting and expanding networks of formal neurons indicated that a mathematic apparatus of analytic logic could be used for calculation of networks of arbitrary complexity (including networks with feedback and loading connections). It was demonstrated that such networks of formal neurons can be used to simulate the conditioned reflex phenomenon which forms the basis of memory, with all its features of formation, reinforcement, extinction and restoration, by adding new connections and by regulating thresholds for wearing out of neurons. Other special (somatic, vegetative, and emotional) brain functions were also simulated in this manner.

209.

AUTHOR: Chichvarina, N. A.

ORG: none

TITLE: Simulation of the decision making process in environments with different types of limitations

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 160-161

TOPIC TAGS: information theory, decision theory, mathematic model, graphic technique

ABSTRACT: The author proposes methods for formalization of information situations based on complex investigation of different languages of description. A list of a set of limitations is presented. A specific information situation can be described in the form of a table, where a strictly defined information problem corresponds to each set of limitations. A specific environment can be described by a system of graphs of

several levels. A class of new information situations dealing with decision making was formally defined, which reduce limitations on the number of slopes in a graph coming from one peak. A formal description of the limitations was given and algorithms were developed. Another class of information problems solvable by man was also formally defined. It was connected with the fact that at each stage of solution active search for missing information takes place. The information necessary at each stage of solution was determined and a search strategy was developed including specific tactics for exclusion of unused operators.

210.

AUTHOR: Chorayan, O. G., Gil'man, Ye. Ya.

CRG: none

TITLE: A Model of the Memory Mechanism

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1957. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1957, 162

TOPIC TAGS: human memory, biologic model, learning process, neuron

ABSTRACT: The processes of fixing and reproducing information on which the memory mechanism is based were investigated empirically. A somewhat modified Hebb's procedure (1962) was used to study the short term memory mechanism. The subject was asked to remember and repeat twenty-five nine digit numbers, in which each fourth number was repeated. The data demonstrated that the mechanism of short term memory is based on reducing the functioning probability of excess collaterals for a given realization of neuron activity patterns and the formation of a specific pattern of neuron network activity. A proposed model of the memory mechanism explaining the increase in importance of the connections in the learning process leads to formation of rigid connections between the number of operations and the number of memory cells. The model makes it possible to explain the relationship of the volume of short term memory to the length of the remembered sequence and to calculate the volume of long term memory. Mechanisms for active change in probability weights of the functioning of interneuron connections are considered.

211.

AUTHOR: Chubarov, A. V.; Zhdanov, P. V.

ORG: none

TITLE: Application of harmonic analysis to investigation of the brain under different functional states

SOURCE: Vsesoyuznaya konferentsiya po neyro-kibernetike, 3d, Rostov-on-Don, 1967. Problemy nevrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 163

TOPIC TAGS: harmonic analysis, brain, visual simulation

ABSTRACT: It was demonstrated that a widely used automatic control system, the method of harmonic analysis, can be applied to the study of individual functional systems of living organisms. Application of this method to investigations of the visual functional formation of the human brain made it possible to construct the amplitude-frequency characteristics of the formation and to describe the qualitative and quantitative aspects of transitional processes corresponding to various levels of the tonic states of the brain. Analysis of the amplitude-frequency characteristics and the transitional processes made it possible to detect the resonance properties of the system and to provide quantitative evaluation of its resonance frequency, constant time, and damping coefficient. Construction of amplitude-frequency characteristics and quantitative evaluation of the above parameters enabled forming a mathematical description of the operation of the system. Limits of linearity of the system were determined to find the region in which the harmonic analysis method can be correctly applied.

212.

AUTHOR: Gasparyan, Yu. M.; Gambaryan, L. S.

ORG: none

TITLE: Conditioned reflex probability model

SOURCE: Vsesoyuznaya konferentsiya po nevrokibernetike, 3d, Rostov-on-Don, 1967. Problemy nevrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 29

TOPIC TAGS: conditioned reflex, biologic model, probability

ABSTRACT: This model has three advantages over existing ones: 1) its work depends on a specific "known" past, since information received earlier is "forgotten" by becoming unnecessary; 2) its characteristics are very close to the real reflex; and, 3) the

proposed model forwards specific information about the role of the reticular formation into the integrated activity of the brain. The model demonstrates that the logic of individual nuclei of the reticular formation must change in relation to past experience. The model allows, with some approximation, explanations of features of the anatomical structure of the reticular formation and hypotheses on the interaction of the cortex and the reticular formation. Methods for realizing the model are shown and a specific model is described.

213.

AUTHOR: Genkin, A. A.

ORG: none

TITLE: Distinguishing EEG signals during different types of mental work

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetike (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 31-32

TOPIC TAGS: man, EEG, signal analysis, learning process

ABSTRACT: The report discusses the informativeness of fifteen statistics for phase durations and their connections with the EEG amplitude. Multidimensional EEG characteristics were found which distinguish reactions even along a single channel with the corresponding decision rule during two types of mental work, irrespective of background and induced spontaneous EEG activity. In 66 experiments on two types of mental work in twenty-two subjects, 35 experiments on ten of the subjects constituted the learning group. The decision rule was based on tests of the ratio likelihood. Discrimination in the learning and control groups is approximately the same, and as a whole correct discrimination was obtained for sixty experiments (91%). These results can lead to understanding the structure of bioelectric signals and to deciphering a code of gradual electric brain phenomena.

214.

AUTHOR: Genkin, A. A.

ORG: none

TITLE: Problems and outlook for statistical methods in neurocybernetics

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 30-31

TOPIC TAGS: brain, EEG, electrocorticogram, statistic analysis, automatic control system, neuron, algorithm, mathematic model, cybernetics

ABSTRACT: Effective statistical approaches to deciphering electrical brain phenomena and simulating certain aspects of the integral work of the brain are explained. Statistical regularities of EEG time structure and spatial organization are discussed and the discreteness of certain EEG statistics is proven. The problem of adequate evaluation of mutual influences of the constant potential, the electrocorticogram, and the peak activity of neurons at one point are examined, as well as the spatial relationships of these processes at two or more points. A concept of the internal properties of bioelectric processes is introduced. The value of research for establishing a connection between the features of electric brain phenomena and manifestations of human activity is assessed. The problem of transfer of neurophysiological data into statistical models and theories of behavior is examined. The properties of sequential statistical algorithms for integration of multidimensional and nonstationary input situations are investigated; these algorithms are acceptable mathematical models of the psychological process of decision making. Statistical analysis of the structure of electric brain processes led to formulation of new problems for the time series theory. It is assumed that solution of these problems will play a substantial role in understanding the regulating mechanisms of the central nervous system.

215.

AUTHOR: Glezer, V. D.

ORG: none

TITLE: Model of a conditioned reflex from the viewpoint of the theory of form recognition

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 32-33

TOPIC TAGS: biologic model, conditioned reflex, neuron, form recognition

ABSTRACT: The basic problem is examined from the viewpoints of the classic theory of higher nervous activity and the theory of form recognition as a problem of differentiation (separation) of input signals. Nerve mechanisms on which this separation is based are considered. Acceptance of the hypothesis that nerve processes move in the real cerebral space leads to loss of generality under complex stimuli, i.e. a model of conditioned reflex formation based on concepts of irradiation, concentration, and induction of basic nerve processes is justified only for a narrow range of simple signals. Generality is not lost if the movement of separated hyperplanes is examined in an abstract multidimensional space whose points correspond to input signals. In a real neuron structure this movement reflects changes in the neuron thresholds whose set determines the code value of a signal. Shifts in the neuron thresholds depend on memory processes.

216.

#### CYBERNETIC MODEL OF ATTENTION

Gol'dman, Yu. Turkmeneskaya iskra, no. 120, 25 May 67, p. 4, col. 1.  
AN7016179

A "cybernetic model of attention" has been constructed by G. Gedevanishvili, Corresponding member, Georgian Academy of Sciences, and Engineer G. Eydel'man. It possesses all of the qualities of the orienting reflex in that it reacts to light, sound, and other stimuli. The model even reproduces the "bursts" of electrical rhythm which occur in the brains of man and animals when they are in an attentive state. This model has been highly praised by specialists and has prospects for analyses of cerebral function during surgical operations under anesthesia or hypothermia. It also serves as a basis for the creation of cybernetic systems characterizing various qualities of higher organisms. [CD]

217.

AUTHOR: Golovan', E. T.; Zaslavskiy, S. Ya.; Ivanov-Muromskiy, V. A.; Meytus, V. Yu.; Starinets, V. S.

ORG: none

TITLE: The structural simulation of rational behavior

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neuocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 33-34

TOPIC TAGS: biologic model, algorithm, behavior pattern

ABSTRACT: Interaction between the external environment and a model, satisfying certain criteria, is examined. A group of algorithms describing this interaction is determined and a static network structure of the model is given, the choice of whose elements depends on the group of algorithms utilized. The requirement for universality and completeness of the system of elements relative to the group of algorithms is important. The dynamic structure of the "input-state-output" system in successive moments of time determines behavior. Problems of localization, continuity, and independence of subsystems describing the dynamic structure are considered. Examples of model behavior are presented.

218.

AUTHOR: Ignat'yev, M. B.; Kan, G. S.; Pokrovskiy, A. M.

ORG: none

TITLE: Methods of structural linguistics as heuristic procedures for analyzing problems of the formation of movements of biological systems

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neuocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 53-54

TOPIC TAGS: animal, automatic control system, neuron, computational linguistics, biologic model, sensory motor area, computer simulation

ABSTRACT: The control system for movements of the claws of the crayfish was examined to establish its rules of operation by observing its functioning as a biological system for the control of movements. In developing such a model of a biological system for formation of movements, it is possible to take advantage of language models developed in mathematical linguistics. Here N. Khomskiy's transformation model was used. A three dimensional system consisting of "k" rods successively joined was investigated wherein the object of control was to place the end of a rod in a prescribed point in space. Grammatical rules developed from the structure of direct

components can be used to construct the simplest motor acts, and more complex movements are obtained by using the corresponding transformations. Results of simulation on a general purpose computer are presented. The volume of the translator was evaluated using both ALGOL and a language developed during the programming of movements. It was attempted to compare the structure of a hypothetical neural network and the structure of a general purpose computer program for the solution of such problems. The results of the investigation can be used to analyze biological systems for control of movements and to synthesize systems for the programmed control of mechanical robot manipulators.

219.

NEUROPHYSIOLOGICAL AND BIOCYBERNETIC ASPECTS OF MEMORY

ORG: none

Ivanov-Muromskiy, K. A., and E. T. Golovan'. AN UkrSSR. Modelirovaniye v meditsine (Modeling in biology and medicine), no. 2, Kiev, Naukova dumka, 1966, 13-18.  
AT7009684

On the basis of recent literature, the following premises appear valid for modeling of memory. First, recording and reproduction of engrams are largely determined by stochastic processes in the brain. Second, recording, storage, and reproduction of engrams are related to the formation of statistical information models of the external medium arranged in a hierachic structure. Third, the model should reflect the structural network of the nervous system consisting of ganglia and pathways. The process of forgetting should not be considered a passive process, a breaking of the circuit, but as a process of active inhibition. Thus, a model simulating the memory should reflect two phases, excitation and the stationary process in which association is preserved in an inhibited state. A model based on transmission of excitation from ganglion to ganglion by discrete and indiscrete signals is described. [06]

220.

AUTHOR: Kasatkin, A. M.

ORG: none

TITLE: Model of purposeful behavior

SOURCE: Vsesoyuznaya konferentsiya po nejrokiernetike, 3d, Rostov-on-Don, 1967. Problemy nejrokiernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 60-61

TOPIC TAGS: biologic model, behavior pattern, automaton, information processing, algorithm

ABSTRACT: The proposed model is part of a program for simulating the purposeful behavior of living organisms; it simulates information processing which organizes activity directed toward survival and is intended for investigation of that activity. The model is a network of elements resembling neurons with semantic organization (X-automaton). The report describes the simulated information processing, gives an algorithm for transmission of stimuli in the network, explains principles of self-learning and self-organization in the model, and presents results of an experiment simulating the formation of concepts.

221.

AN HEURISTIC MODEL OF SOME INFORMATION PROCESSING PROCESSES OF THE BRAIN

Kasatkin, A. M., and L. M. Kasatkina. AN UkrSSR. Modelirovaniye v biologii i meditsine (Modeling in biology and medicine), no. 2. Kiev, Naukova dumka, 1966, 62-71. AT7009687

The authors present an heuristic model of some information processing functions of the brain based on N. M. Amosov's hypotheses. The proposed system operates in a medium (locality) consisting of cells or squares each of which can be empty or can contain an object of the external medium (see Fig. 1), where 1, 2....., n are different objects

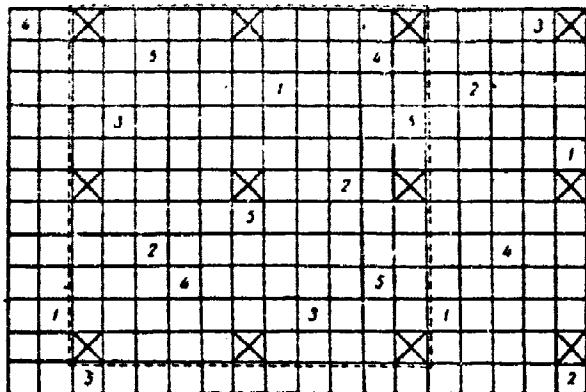


Fig. 1.

of the medium and X is a reference point. Movement is accomplished by taking steps leading the system from one square to the next. The purpose is to reach a certain square in the medium. The system finding itself in one of the squares "sees" the squares directly around it and reacts to the objects within the squares by taking the proper step. Objects of the medium squares are divided into two categories, dangerous and useful; the system avoids the dangerous objects and aims for the useful ones. The system structure consists of models organized on several levels to approximate lower and higher brain activity. Each model corresponds to a certain code. When input information is separated into codes, the corresponding models are excited. Duration of excitation depends on the structural level of the model. Associative connections exist between models of each level. Structures of the emotional, logical, and motor spheres are organized in a similar manner. Due to the presence of circuits between the spheres and between the various models, at each moment of time simultaneous excitation of a number of models takes place, which is related in some way to input information. An amplification-braking (inhibiting) system (SUT) separates the most important information and amplifies the excitation of the corresponding models (see Fig. 2). At

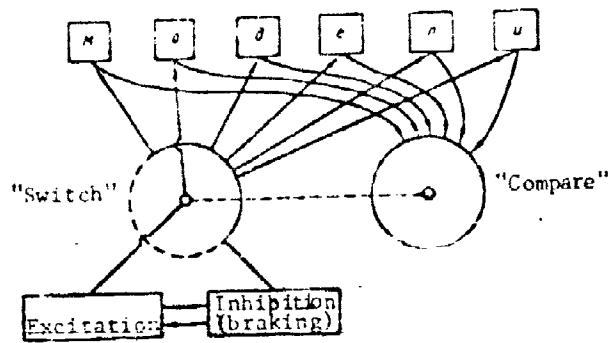


Fig. 2.

each moment the excitation levels of the models are compared and the model with the highest excitation is connected to the SUT system for amplification with intensity dependent on the emotional sphere; the other models are inhibited by braking. The sequence of information processing steps is considered in detail. At the present time a simplified variant of the information processing system is being modeled on an EVN M-20 computer. Preliminary results are reported to be satisfactory.

222.

AUTHOR: Kasatkina, L. M.

ORG: none

TITLE: Experimental investigation of a model of motor behavior

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 61

TOPIC TAGS: neuron, information processing, automaton, cerebral cortex, digital computer, sensory motor area

ABSTRACT: A method of simulating information processes of the cerebral cortex with M-automatons which are systems of interdependent elements resembling neurons is briefly described, and a concept about incomplete and complete M-automatons is introduced. An incomplete M-automaton simulating information processing connected with formation of motor behavior was realized in the form of a complex of digital computer programs. A method for construction of a preliminary plan of behavior in

static environments of a specific class using the M-automaton is explained; the plan is directed toward attainment of a specified aim and involves a choice of a hierarchy of intermediate aims and the formation of special tracking systems. A complete M-automaton which is part of the proposed system is used to realize the plan. The behavior of this automaton is expressed by its shifts in a given environment, and this behavior is compared with the results of a psychological experiment.

223.

AUTHOR: Kissin, M. Ye.

ORG: none

TITLE: Toward creation of heuristic programming methods for scheduling

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 63

TOPIC TAGS: heuristic programming, brain, algorithm, operations research

ABSTRACT: A type of information problem solvable by man called a "combinatorial-dynamic" problem was selected for investigation. The problem is to find a set of time sequences of applications of the sum of operators for a series of objects, which converts a set of initial objects into series of finite objects so that criteria whose parameter is time will be satisfied. Three conditions must be jointly fulfilled in order to apply the operator to an arbitrary object at a given moment of time: 1) presence of a corresponding operation among the set of operations which the operator can accomplish; 2) availability of the operator at a given moment of time; and, 3) availability of the object. The investigation showed that the "combinatorial-dynamic" problem is the essence of large problems in different areas of human activity involved in the theory of operations research into problems of scheduling. The structure of the "combinatorial-dynamic" problem was obtained by algorithmic analysis of the work of the brain, and various heuristic rules and tactics were investigated. Fundamental principles for constructing a system of classification for problems of this type are examined.

224.

PHYSICOCHEMICAL SIMULATION OF INFORMATION AND THINKING PROCESSES.  
PART 3. SYSTEMIC PROCESSES AND TYPES OF THEIR REPRESENTATION

ORG: Moscow State University im. M.V. Lomonosov, Department  
of Chemistry (Moskovskiy gosudarstvenny universitet,  
Khimicheskiy fakul'tet)

Kobozev, N. I. Zhurnal fizicheskoy khimii, v. 41, no. 7, 1967,  
1723-1730.

AP7024778

The paper presents arguments in support of the application of thermodynamics to the process of thinking on the systemic level. It is shown that a general method of reducing the role of molecular entropy in the functions of an organ, organism or mechanism consists in increasing the degree of macroscopicity  $\gamma_M$  of its acting elements, as a result of which the macroscopic entropy  $S_M$  begins to displace the molecular entropy  $S_m$ :  $S_{\text{svst}} = \gamma_M S_M + (1-\gamma_M) S_m$ . The relation  $\gamma_M = 1$  and  $S_{\text{svst}} = S_M = 0$  is unattainable, and therefore the brain as a physicochemical system cannot be devoid of entropy, whether of molecular or systemic level. The thinking (logical) production of the physicochemical operations of the brain constitutes production which can be coded exactly, transmitted along a communication channel, and very adequately received at a receiving point. Such production is completely devoid of entropy, both informational and physical, whereas the physicochemical apparatus of the brain which originates it has a physical entropy of molecular and systemic level (the next paper will deal with the solution of this "thermodynamic paradox of thinking"). It is shown that since the set of physicochemical operations of the brain and the set of elements of the logical production generated by it are both finite and countable, an equivalence can always arise between the set of logical production and some subset of physicochemical operations of the brain. This limiting condition is sufficient for the application of the thermodynamically statistical method of analysis to the thinking process not only on the molecular but also on the systemic level. [27]

225.

AUTHOR: Kogan, A. B.

ORG: none

TITLE: Probabilistic statistical organization as the basis of the ultrahigh reliability of the brain

SOURCE: AN SSSR. Nauchnyy sovet po kompleksnoy probleme "Kibernetika". Voprosy bioniki (Problems of bionics) Moscow, Izd-vo "Nauka", 1967, 139-144

TOPIC TAGS: bionics, stochastic process, control statistics, probabilistic automaton, switching theory, human sense, brain, system reliability

ABSTRACT: The high reliability of the human brain is explored on the basis of the probabilistic-statistical hypothesis. This hypothesis gives a possible explanation for the mechanism of the compensation for functions by duplicate nerve cell elements, for "random" pulses of neurons, and for the capacity of nerve centers to function despite partial destruction. The brain's reliability is discussed in terms of the tenacity coefficient defined as the ratio of the various states in which the system functions to the total number of possible states.. Thus, with  $n$  elements there are

$2^n$  possible states, some of which are functional. Clinical observations have revealed that human senses continue to function up to the point where 30—40% of the nerve mass is destroyed and then rapidly cease to function. This phenomenon is explained not by the duplication of elements in the brain but by stochastic coupling of the elements, as was verified by experiments which confirmed a priori predictions of loss of vision after partial destruction of the image. In lower animals and in the lower nerve functions (involving the spinal cord) of man, fixed function nets do exist, but evolutionary processes have forced the brain to adopt the more flexible and reliable stochastic coupling. Further work on nerve aggregates should involve studies on autocorrelation functions and metabolic activity. Orig. art. has: 3 figures.

226.

AUTHOR: Krapivnyy, A.

CRG: none

TITLE: Simulation of extrapolation reactions of animal behavior in connection with differentiation of a complex signal

SOURCE: Vsesoyuznaya konferentsiya po neirokibernetike, 3d, Rostov-on-Don, 1967. Problemy neirokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 75

TOPIC TAGS: animal, learning process, mathematic model, signal processing

ABSTRACT: A stochastic learning model which takes an extrapolation reaction into account has been previously presented. Ethological characteristics of individual species of animals were established by numerical values of the parameters. The model describes the behavior of animals in the first stage of learning (the first ten to thirty trials), but in the next stage the animal can learn to solve a problem better than the model. This is explained by an emerging capacity to differentiate the signals. Thus ( $P_{ik}^1 = P_{ik}^2$ ) coincide only in the initial moment of both blocks, but separation takes place in proportion to differentiation of signal A. Special experiments for study of the quantitative expression of the capacity for differentiation of signals by animals demonstrated that any complex signal consists of interdependent subsignals, each of which has a common part C with an adjacent subsignal. Subsignals A and B have a common part C, so that  $A = A_1 + C$ ,  $B = B_1 + C$  ( $C = A \wedge B$ ). Experiments demonstrated that if C is not very large, i. e. if A and B are not very close, then it is possible to arrange matters so that  $P(\alpha/\lambda/A)$  is equal to  $P(\beta/\lambda/B)$ . With the gradual convergence of A and B, i. e. with increase of C, the critical value  $C = C_{cr}$  approaches after which the probability  $P(\alpha/\lambda/A)$  and  $P(\beta/\lambda/B)$  sharply decreases. It is necessary to establish the dynamics of the origin of temporary connections. The asymptotic behavior of the process is of particular interest.

327.

AUTHOR: Kravzner, L. P.

S: none

JEL: Modern concepts concerning human memory and bionic methods for constructing storage devices of cybernetic machines

SOURCE: AN SSSR. Nauchnyy sovet po kompleksnoy probleme "Kibernetika". Voprosy bioniki (Problems of bionics) Moscow, Izd-vo "Nauka", 1967, 213-218

KEY WORDS: bionics, computer memory, memory time, human physiology, human sense, mechanics, computer storage, biocybernetics, brain tissue

ABSTRACT: A comparative analysis of human memory and a computer storage is made. The functioning of human memory is analyzed, and the direction of research is indicated for producing computer memories operating on the same principle as human memory. In comparison with a computer storage, our memory is far larger (up to  $10^{21}$  bits), has a higher storage density (up to  $10^{23}$  bits/cm<sup>3</sup> in the cell's nucleus), uses considerably less energy but has approximately the same access time of  $10^{-15}$  sec/bit. The method of entering information differs considerably. The brain has two distinct types of memory: operative or short-term memory, and a long-term memory. The operative memory (effective for up to 10 min) results from the recirculation of the data pulse through the nerve network. This recirculation leads to structural changes in the brain which produce the long-term memory. These structural changes may involve growth of protoplasmic nerve branches, morphological changes in the synapses, or, even more probably, molecular changes in the RNA and in the proteins of the nerve cells. Future studies, at which mathematical models and electronic circuits may prove useful, should proceed on four levels: 1) the structural level which will involve large functional units; 2) the network level at which studies of the interneuron connections would be conducted; 3) the cell level for studies of neuron activity and changes of state; 4) the molecular level for defining the role of RNA. Orig. art. has: 1 figure and 2 tables.

AUTHOR: Kruglikov, N. I.

ORG: none

TITLE: Correlation of short term and long term memory

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 76

TOPIC TAGS: neuron, human memory

ABSTRACT: It is well known that the memory trace (the engram) changes its formation from a labile, slightly disrupted form (short term memory) into an extraordinarily stable form (long term memory). Yet the content of the memory trace does not change in this process of consolidation. It is very probable that storage of the engram at various stages of its formation is linked with the activity of the same neuron systems, in spite of differences in the mechanisms of short term and long term memory. The dynamic processes of the type of reverberatory activity, which take place in a specific multineuron system and form the basis of the memory trace at the stage of short term memory, lead to formation of a structurally reinforced multineuron system-engram with a speed proportional to the importance of the information. However, this speed is apparently determined not only by the speed of the process of consolidation itself but also by the ordinate of the starting point of this process (Cherkin, 1966). The basic role in realizing the process of consolidation is played by the relationship between the function and the genetic apparatus in a given system of neurons (Mayerson, 1963; Mayerson and Kruglikov, 1966).

229.

AUTHOR: Malikov, N. K.

ORG: none

TITLE: Elements of heuristic programming theory and method

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 81

TOPIC TAGS: mathematic model, computer simulation, behavior pattern, heuristic programming

ABSTRACT: Development of the theory and practice of heuristic programming depends to a considerable extent on the study of such fundamental problems as the structural plan of the process of cognition (thought) and its connection with the structural plan of heuristic programming. A structural plan of heuristic programming is established on the basis of a structural plan of the process of cognition. Heuristic programming methods are discussed, certain heuristic programs of behavior are analyzed, and fundamental problems in the theory and practice of heuristic programming are formulated.

230.

MODELING VOLUNTARY BEHAVIOR IN A SIMPLE ENVIRONMENT

ORG: Institute of Normal and Pathological Physiology, Academy  
of Medical Sciences SSSR, Moscow (Institut normal'noy  
i patologicheskoy fiziologii AMN SSSR)

Kuz'menko, V. A. Soveshchaniye po problemam vysshey nervnoy deyatel'nosti, 21st, 1966. Tezisy i referaty dokladov. Moscow, Izd-vo "Nauka," 1966. 166. AT7024086

Adaptive activity of animals is based on their ability to model the external environment. Thus, any behavioral act is realized as a result of model regulation; that is, it is reduced to eliminating any disagreement between the external environment and its internal model both in the efferent and afferent systems. On the basis of these principles, a simple automatic model is proposed in the form of a Y-shaped labyrinth with four units: an afferent unit, an efferent unit, a motivation unit, and a memory unit. The afferent unit is designed to construct an adequate model of the external environment during perception. The efferent unit is designed to "adjust" the model to the environment by eliminating disagreement between the model and the environment. Vital constants are concentrated in the motivation unit, and information storage and retrieval take place in the memory unit. Afferent synthesis in the model ends with the formation of a future model corresponding to present motivation, memory, and the environment. Choice of action is made following agreement with preceding external factors, and consists of transferring the operative processes of the expected external factor to the model. A subsequent comparison of the environment and model, depending on the adequacy of the latter, proceeds as "recognition" or "orientation activity." The model adjusts to the environment ("learns") after several contacts, and the degree of learning increases with transition from orientation activity to stereotype activity. As a result, the model not only maintains its vital constants, but gradually reduces the period of disagreement between itself and external environment. [06]

231.

AUTHOR: Kvinikhidze, K. S.; Mel'nikova, Ye. A.

ORG: none

TITLE: A possible mechanism for forming short term and long term memory traces

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 62-63

TOPIC TAGS: neuron, human memory

ABSTRACT: Theoretical mechanisms for formation of memory traces on various levels are examined based on certain cytologic and biochemical investigations encompassing both intracellular and extracellular changes in nerve tissue, and also based on comparing times for the course of biochemical (molecular) processes in the neuron.

232.

AUTHOR: Ibov, G. S.

ORG: Institute of Mathematics of the Sibirsk Division AN SSSR, Novosibirsk (In-t matematiki Sibirskogo otdeleniya AN SSSR)

TITLE: Heuristic programming applying the principle of perceptron operation

SOURCE: Nezhvuzovskaya nauchnaya konferentsiya po neyrokibernetike, 2d, Rostov-on-Don, 1965. Problemy neyrokibernetiki (Problems of neurocybernetics); materialy konferentsii, v. 2, Rostov-on-Don, Izd-vo Rostovskogo univ., 1966, 235-236

TOPIC TAGS: intelligent programming system, algorithm, random process, form recognition

ABSTRACT: A heuristic algorithm of random search, which utilizes the basic principle of perceptron operation, is suggested for solving problems in image recognition where the number of characteristics must be minimized. Given an initial system of characteristics  $X$  ( $X_1 \dots X_n$ ) on which a sample space  $R_n$  is constructed, the most informative subspace must be designated, based on  $m$  characteristics selected from the initial system ( $m$  is fixed, and less than  $n$ ). The presently proposed method consists of random search of the most informative subspace with "incentive" and "penalty" of the individual characteristics from  $X_1 \dots X_n$ . At the start of the search the

selection probability  $P_1 \dots P_n$  for each of the characteristics  $X_1 \dots X_n$  is assigned, and if there is no information on the preferableness of selecting a given characteristic, the probabilities are assumed to be  $P = 1/n$ . This "incentive" and "penalty" of the characteristics  $X_1 \dots X_n$  leads to changes in the probabilities  $P_1 \dots P_n$  of selecting characteristics for the following stage of the search, depending on results of preceding stages. In cases where complete sorting of subspaces was carried out, it was shown that the proposed algorithm selected optimal subspaces. The algorithm of random search with adaptation gave better results in recognition problems than the method of directed sorting. Detailed description of this algorithm, its experimental verification, and comparison with known methods of directed sorting may be found in the author's previous articles cited among the references.

233.

AUTHOR: Lefevr, V. A.

ORG: none

TITLE: One type of rational behavior formation

SOURCE: AN SSSR. Nauchnyy sovet po kompleksnoy probleme "Kibernetika". Voprosy bioniki (Problems of bionics) Moscow, Izd-vo "Nauka", 1967. 298-299

TOPIC TAGS: learning process, behavior pattern, human memory, psychic stimulation, sleep

ABSTRACT: Despite the title the article concerns two types of rational behavior formation. The first type is characterized by the formation of a universal method for solving problems of a certain class. The solving of separate problems is accomplished as they appear from the environment. The conditions for each concrete problem are not fixed in the memory of the system until the problem presents itself. Thus, most of the problems and their solutions do not actually exist in the system. In the second type, formation of rational behavior is singled out in relation to a class of problems when the universal method does not apply. In this case each problem and the specific method of its solution must be entered into the system memory. One possible realization of the second type of rational behavior formation is examined. It can be hypothesized that dreaming is a special process of self learning for some biological systems. An animal in the process of dreaming and coming into contact with a modified image of the surrounding world works out special types of behavior necessary for overcoming problems which arise, especially for situations endangering one's life. Having worked out a rational behavior pattern for a given situation

during dreaming, the animal can significantly increase the probability of his survival if he should actually face a similar situation. A simple diagram of a system that dreams can be constructed. Let A represent the system that learns. The learning process proceeds under two types of operating conditions: active learning (interaction with the real environment) and learning by means of dreaming. System A consists of units B and C. Unit B is for forming solutions to problems and unit C is for modifying and extrapolating problems. Unit T, which is an external element in relation to system A, is introduced to represent a "trainer" or "environment." Unit T presents the problems ( $P_1$ ,  $P_2$ ,  $P_3$ ) to system A and by means of interaction with system A, the latter learns; the means of solving the problem by interaction is formed in unit B. At the same time memory of problems  $P_1$ ,  $P_2$  and  $P_3$  is stored in unit C. Under the second type of operating conditions the external "trainer" element T is switched off and in its place unit C of modification and extrapolation starts to operate. Unit C makes contacts with the inputs and outputs of unit B which formerly were in contact with unit T. On the basis of  $P_1$ ,  $P_2$  and  $P_3$  stored in the memory, an extrapolational sequence of problems  $P_4$ ,  $P_5$  and  $P_6$  is formed. The results of such internal learning or self learning by means of dreaming are developed by the system for solving problems  $P_4$ ,  $P_5$  and  $P_6$  which have never been presented by the external environment. Possibly, some cycles of dreaming in which the behavior formed is important for a given species are transmitted by heredity in the form of a unique movie film which gives the general plan of a situation rather than concrete details. The author suggests that the described mechanism historically preceded the appearance of psychic phenomena. The latter appears to be the result of the inputs and outputs of the "imitator-modificator" coming into direct contact with the receptors of an animal or man, and thereby the process of dreaming proceeds synchronously with the perception process.

234.

AUTHOR: Liberman, A. Ye.

ORG: Kharkov Institute of Advanced Study for Doctors (Khar'kovskiy institut usovremenstvovaniya vrachoy)

TITLE: On the methodology of physiological investigation of thought processes

SOURCE: Soveshchaniye po problemam vyschey nervnoy doyatel'nosti, 21st, 1966. Tezisy i referaty dokladov. Moscow, Izd-vo "Nauka", 1966, 179

TOPIC TAGS: thought process, conditioned reflex, biologic model

ABSTRACT: Physiological investigations of thought processes as expressed by speech are marked by a number of methodological difficulties. These difficulties stem from the many meanings of a single word, dependence of word meaning on context, and individual differences of semantics and vocabulary in formulating ideas. With the generally accepted methods (associative experiment, speech-motor) of investigation,

these difficulties are not overcome. A more productive method is that of conditioned reflex formation of "artificial concepts", but its use is primarily limited to elementary abstractions and does not consider their qualitative differences, making the analysis of more complex thought processes (evaluations, conclusions, proofs et al.) impossible. The separate formation of concepts related to the categories of things, qualities and relationships is investigated. This formation of concepts differs in its logico-gnosiological and physiological aspects. Physiological modeling of thought should be related to its logical formalization. Investigation of the various methods of forming abstractions increases the possibility of a well defined and differentiated neurodynamic interpretation of normal and disturbed thought processes. Orig. art. has: none.

235.

AUTHOR: Lyaudis, V. Ya.

ORG: none

TITLE: The functional features of the process of remembering

SOURCE: AN SSSR. Nauchnyy sovet po kompleksnoy probleme "Kibernetika". Voprosy bioniki (Problems of bionics) Moscow, Izd-vo "Nauka", 1967, 232-237

TOPIC TAGS: central nervous system, human memory, human physiology, automation

ABSTRACT: The structural features of the human memory process were studied to acquire knowledge applicable for the automation of intellectual activity. A symbol alphabet of 32 elements based on five characteristics was constructed for this purpose. Groups of 12 elements were presented to test subjects for one minute, and the subjects (university mathematics students) were required to name the characteristics of each element. Test subjects were subsequently given instruction in identifying and grouping the characteristics; after the first stage in instruction there was noticeable improvement in the test indices. Table 1 illustrates this progress, with data on the time and percentage of error for selective reproduction at various stages of instruction. The experiments show that a planned structure of operations ensures optimum conditions for improving memory. Tests of selective reproduction show that the

Table 1  
Time and errors in selective reproduction at various stages of learning

Indices	Criteria for grouping	Test series		
		Prior to instruction	First stage of instruction	Second stage of instruction
Time (sec.)	Basic	17.0	9.7	6.2
	Supplementary	23.4	16.6	9.5
Errors (%)	Basic	10.0	—	—
	Supplementary	39.0	17.0	—

quality of the mental model of the image changes with instruction. The experiments revealed new functional properties of the operation of separating groups and bringing order into intra- and inter-group relationships. It was further demonstrated that the rapidity and correctness of selective reproduction are the result of establishing a system of element relationships. Orig. art. has: 3 figures and 2 tables.

236.

AUTHOR: Napalkov, A. V.

ORG: none

TITLE: Classification of information processes and the study of the work mechanisms of the brain

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 99

TOPIC TAGS: information processing, brain, heuristic programming, computer programming, algorithm

ABSTRACT: Special classification tables were drawn up in which each of the systems of limitations was established in accordance with an heuristic program.. The classification system used a higher category than formalization on the basis of the language of the theory of associated calculations. The classification was based on a complex of limitations and each of the classes combined a large number of problems described by different associated calculations. This classification of information problems permitted a new approach to the investigation of brain mechanisms. After determining the individual classes of self-learning, problem solution, and

recognition, complex systems of heuristics and algorithms were developed for each class. Examples of certain programs are presented which indicate that it is impossible to reduce mechanisms for work of the brain to schemes previously used in physiology. Instead, it is necessary to develop a new concept of information structure concerning the specific organization of information processing blocks and concerning the circulation of information.

237.

AUTHOR: Napalkov, A. V.; Ioragimbekova, Sh. S.; Semenova, B. V.

ORG: none

TITLE: Heuristic programs and mechanisms for development of experimental hypertension

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 99-100

TOPIC TAGS: computer programming, heuristic programming, dog, brain, neuropathology, blood pressure, conditioned reflex, algorithm

ABSTRACT: Algorithms for work of the brain in pathologic and neurotic conditions, algorithms for conversion of the work of the brain from one level to another, and mechanisms for the genesis of disturbances were investigated in experiments on ten dogs in which stable hypertension was induced and the blood pressure level reached 180-190 mm. It was demonstrated that the genesis mechanism is not the formation of a simple conditioned reflex, but a series of factors in sequence: 1) preliminary development of a conditioned reflex to defense stimuli; 2) single action of a strong stimulus, unknown to the dog, inducing emotions of fear; 3) cessation of repeated application of the stimulus; and, 4) application of a conditioned signal without reinforcement of its unconditioned stimulus. Stable hypertension could appear only with such a sequence of signals. Genesis of a neurotic condition in the dogs was followed by development of other algorithms for self-learning and other algorithms for information processing. Changes occurred in the rates of development and extinction of reflexes. After preliminary extinction of certain reflexes was induced, the conditions described above did not lead to stable hypertension. It was discovered that during the growth of a pathological condition manifested in hypertension, disturbances occur on higher levels, i. e. a stable disturbance occurs in the work of heuristic programs of a higher level. This disturbance proves to be most important, since it leads to formation of a large number of new programs of lower levels.

230.

AUTHOR: Napalkov, A. V.; Korneyev, Yu. K.; Polynkov, V. K.

ORG: none

TITLE: Classification of some information problems solvable by man in the process of recognition

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 100-101

TOPIC TAGS: recognition process, experimental psychology, brain, man, heuristic programming

ABSTRACT: Recognition of forms on the basis of a clearer classification of information problems in different situations was investigated, based on analysis of the work of the human brain during recognition of visual, auditory, and other types of forms. The classification resulted in the following plan of action during solution of the information problem of recognition by man: 1) detection (the problem of recognition itself is analyzed in rough form); 2) discrimination (the choice of an algorithm leading to identification of the object); 3) identification (verification of the effectiveness of the algorithm used); and, 4) evaluation of the significance of the information (for the organism as a whole, by proceeding from a given class of problems). The work of the brain during recognition is thus considered in the form of heuristic programs of different levels. A similar approach is confirmed in problems solvable by man. This classification provides a more systematic approach to criteria for evaluation of separate stages of recognition and a more systematic consolidation of them during evaluation of perception as a whole. Better classification of problems allows the selection and experimental investigation of more complex heuristic principles of recognition, which apply not only to the present case but have universal value.

239.

AUTHOR: Napalkov, A. V.; Novikov, P. P.; Gantman, Yu. N.; Barbashina, V. N.; Semenova, B. V.

ORG: none

TITLE: Simulation of human behavior in the solution of extremal problems

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 101

TOPIC TAGS: behavior pattern, mathematic model, algorithm, computer simulation, man

ABSTRACT: The results of experiments and algorithms of human behavior in finding a total extreme in a series of problems and described functions from one and two variables with one or several extremes are examined. A strong limitation (the presence of a functional relationship) allows a clear description of the subject's behavior during problem solving. A problem solving information model is described. A number of information mechanism algorithms are distinguished, such as search, subpurposes, choice of the size and direction of step, and choice of evaluations of the finite chain. Each information mechanism consists of three hierarchical parts: the algorithm itself, the learning algorithm, and the algorithm which generates new rules for information processing. Block diagrams of algorithms and the results of their computer simulation are presented, and the algorithms are compared with mathematic methods of solving analogous problems and limits of their applicability are given.

240.

#### HEURISTIC PROGRAMS AS A BASIS FOR THE OPERATION OF SELF-ORGANIZING AND SELF-TEACHING SYSTEMS

ORG: Moscow State University (MGU)

Napalkov, A. V., N. N. Rodman, and B. A. Dashevskiy. Mezhdunarodnaya nauchnaya konferentsiya po neyrokibernetike, 2d, Rostov-on-Don, 1965. Problemy neyrokibernetiki (Problems of neurocybernetics); materialy konferentsii. v. 2. Rostov-on-Don, Izd-vo Rostovskogo univ., 1966, 213-219. AT7033550

This article is basically a review and appraisal of theories and methods that have been and are being developed in the field of heuristic programming. Heuristic programming is based upon the analysis of information processes in the brain. In studying the mechanisms of such complex mental functions as image recognition, self-teaching, and problem-

solving, the underlying "elementary information processes" should be determined and the following question should be answered: how are certain heuristic programs developed from specially formed, organized structures, consisting of elementary processes.

Work is being done in this area at the Laboratory of Information Processes of Moscow University. The first stage in this work is the development of a formal code suitable for various information situations. The basic aim is to ascertain the limiting factors in information situations which make possible the use of fixed algorithms. Limiting factors are understood to be principles of organization of an information system.

The procedure for resolving information problems is always based on the presence of a given set of limiting factors. In life, the individual is usually concerned with information problems which are influenced by significantly strong sets of limiting factors. In the analysis of the mechanisms of mental activity, it is important first of all to ascertain the systems of limiting factors in the problems solved in the individual's mind, and then to determine the functional dependence between these limiting factors and the algorithms employed by the nervous system. It seems that the most effective method of analyzing mechanisms of the higher nervous system is disclosing and theoretically analyzing the algorithm and constructing a cybernetic model based on the algorithm.

From another point of view it has been established that special methods of formalization are necessary for describing information problems which have different levels or which are incomplete and unexpressed. To this end, several codes based on various theories have been considered. Each of these codes, however, had certain drawbacks. Thus, special methods were used for developing a formal code suitable in all cases. On the basis of the studies conducted it was not possible to find a universal system for the formalization of all problems, but suitable methods of formalization for each type of information process have been found. A classification system was developed for information systems, with consideration of the varying nature of the limiting factors involved.

There are at present many self-teaching automatic machines and many research methods in the self-teaching of organisms. It seems necessary, in the development of any new cybernetic device, that the system of limiting factors under which the device will function most effectively should be determined accurately. It is very important to create a classification system for various types of information situations and to ascertain on this basis the systems of limiting factors under which existing cybernetic devices cannot function. The prerequisites for accomplishing this are: the absence of multi-level organization in the structure of the information situation, the absence of a situation with unexpressed or incomplete information, and the presence of limiting factors for certain types of shifts from one condition to another.

N. N. Rodman and N. A. Chichvarina have studied other types of information systems, in which limiting factors were not considered. These systems proved to be ineffective in problem-solving. N. A. Chichvarina developed experimental methods and performed experiments in which pertinent algorithms were discovered. A more detailed explanation of these algorithms is given in the reports of N. A. Chichvarina, V. E. Sozhkov, and P. F. Novikov.

Certain heuristic programs, including a series of systems, were formed on the basis of these algorithms. This methodology resulted in a more precise evaluation of the effectiveness of experimental efforts (actions directed towards study of the external world). As a result of the work of the memory algorithm of an automat, a complex system with a dendritic structure is formed (a system of conditioned reflexes). This structure is very convenient for use in the formation, under new conditions, of a new set of behavioral reactions on the basis of earlier "experience."

Special experiments revealed the algorithms which serve as a basis for the formation of new behavior when a completely new information situation has been created. Under these conditions, previous experience is utilized in new conditions for new goals. The algorithms were found and a program, based on the principle of successive comparison of the memory's list-like structure and the initial situation, was established.

In experiments conducted by N. A. Chichvarina and V. V. Movchan, the algorithm always accurately calculated the value of given information, determining expediency and continuity in searching for additional information. A program of this type provides for the formation of new behavior in new environmental conditions, on the basis of previous experience. This permits the labile reconstruction of systems of automatic regulation in new conditions.

There is another type of heuristic program whose distinguishing characteristic is the search for additional information during the actual solving process. In this program, the exact kind of additional information needed is ascertained.

A special series of experiments was devoted to research tactics in constant environments with the presence of several extreme points. Most interesting were the cases in which it is necessary to rely not on the basis of direct change of the optimum parameter, but on the basis of indirect data, i.e., on the basis of changing of signals which have only an indirect relation to the optimum signal.

In the development of heuristic programs, attempts have been made to analyze the structural patterns in the functioning of the brain. It is necessary to isolate the various systems controlling specific functions. If these systems are not considered, the program will contain many excessive elements. The existence in the brain of sections fulfilling analogous functions is very likely. Proof of this hypothesis will be of tremendous assistance in the analysis of experimental data. Even

more effective are hypotheses which provide for a prediction of what will result if a certain system is eliminated or if a breakdown occurs in information circulation between the systems. The concurrence of predicted results with the experimental data is an affirmation of the applicability of certain general theoretical principles. However, detailed concurrence of cybernetic theory with mechanisms of the brain that are being studied is not likely at this time. [AC]

241.

AUTHOR: Nesterenko, A. I.

CG: none

TITLE: Heuristic program for the formation of rational behavior in new situations

SOURCE: Vsesoyuznaya konferentsiya po neyrokiernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokiernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 102-103

TOPIC TAGS: heuristic programming, behavior pattern, biologic model, human memory

ABSTRACT: The capacity of the brain to form new rational behavior in completely new situations was simulated. Programming was based on systematic comparison of new information and information stored in memory. The complex of external stimuli arriving at tree-shaped information structure of the memory increased the excitability of specific elements of the structure. Search was simultaneously carried out along different parts of the structure, and tree branches were surveyed with a thoroughness depending on the significance of the information. If the "indeterminacy function" surpassed a specific threshold, an algorithm of active search was switched on. The "indeterminacy function" depended on: 1) the length of the "branch of the tree" from the point of aim to the point of stimulation; 2) the number of nodes encountered during survey of a given pathway; 3) the number of stimuli in a conjunctive and disjunctive node; and, 4) the number of stimuli in a conjunctive node which are present at a given moment in the external world. Several possible variations of behavior were formulated and compared, and specific behavior was selected. In a number of cases, if behavior formulation was not possible in one part of the structure, recombination of different branches was observed in the memory. The simulation demonstrated the limit of applicability of the program and the conditions of its effective application.

242.

AUTHOR: Novikov, P. P.; Parfenova, L. P.; Dankin, D. M.; Kartashev, D. N.

ORG: none

TITLE: Algorithms for programs of behavior under conditions of minimal information about the environment

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 104-105

TOPIC TAGS: behavior pattern, algorithm, mathematic model, computer simulation, computer memory

ABSTRACT: Two algorithms for behavior formation under conditions of minimal information about the environment were developed in experiments with man and animals. The experimental environment was a discrete branching process with nodes of the "and" or "or" types, and with "prohibition" nodes. Three large functional blocks were distinguished in the algorithms: planning of search, of learning, and of control. The program memory consists of four sections: "impression," short term memory, list long term memory, and high speed long term memory, which are distinguished by designation, volume, method, and access speed. The complex structure of the memory provides lability of the program during processing of input information. The algorithms were simulated on a digital computer and compared with the behavior of the living system, and the results of simulation and limits of application of these algorithms are given.

243.

AUTHOR: Nutsubidze, M. A.

ORG: none

TITLE: Effect of destruction of nonspecific nuclei of optic thalami and the negative emotional reactions of fear and rage on short term memory

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 107

TOPIC TAGS: cat, memory trace, emotion, visual physiology

ABSTRACT: The duration of preservation of traces of auditory and visual stimuli in short term memory (equal to three minutes) was investigated in cats. The destruction of nonspecific nuclei of optic thalami (the centromedial, paracentral, reticular, and parafascicular nuclei) considerably reduced the duration of preservation of excitation

traces. Two months after destruction short term memory was only 5-10 sec. Thalamic nonspecific nuclei enter the system of nerve structures (in the neocortex, the hippocampus, and the amygdaloid nucleus) participating in the preservation of excitation traces. Emotional reactions of fear or rage induced in cats at time of the trace excitation (delayed reactions) disturbs these traces.

244.

AUTHOR: Oganesyants, M. A.

ORG: none

TITLE: Self organization in the activity of the brain

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 108

TOPIC TAGS: adaptation, brain, self organization, dog, heart, conditioned reflex

ABSTRACT: Study of adaptive conditioned reflex systems establishes that their internal organization improves in proportion to repetition of special, random, and noise stimuli. The process is expressed by appearance in the system of new elements and connections (both direct and feedback), strengthening of the interrelation between elements, and their transition from individual-stochastic behavior to deterministic general behavior with decrease in the degree of freedom of each element. A group of mechanisms designated under the term "adaptation" is the neurophysiological basis for formation of elements of the system, and reciprocal effects of the elements follow laws for functioning of a temporary connection. The direction of evolution of the system is dictated by the set of prepared programs (programs of sequential and branched chains, a space-time extrapolation program of trial and error, programs for random search, and others). This report examines the dynamics of self organization based on the time parameter for four conditioned heart reflexes in dogs with reinforcement by painful stimulation.

245.

AUTHOR: Orfeyev, Yu. V.

ORG: none

TITLE: Problems of the relationship of heuristic programming and organization theory

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 108-109

TOPIC TAGS: heuristic programming, organization theory, control theory, information theory

ABSTRACT: The characteristic feature of the organization of complex controlling processes is their hierarchic structure, which has many advantages over structures of other kinds. In hierarchic structures the flow of controlling and informative information is minimal compared to flows in other structures, and complex hierarchic organization systems can evolve much more rapidly. The present report examines the oligomerization of homologous organs in the process of evolution and the possibility of the appearance of heuristic mechanisms of biological evolution which can greatly accelerate the rates of evolutionary transformations.

246.

AUTHOR: Parachev, A. M.

ORG: none

TITLE: Models of collective behavior

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 111

TOPIC TAGS: behavior simulation, social structure

ABSTRACT: Analogy with social organizations proved productive for study of the problem of coordination. Social structures and their corresponding models were divided into the following categories: competitive, cooperative, equal, and totalitarian. Each structure permits interpretation in terms of the organization of individual behavior. The use of such models leads to simple explanations of the maturation of an idea for solution of a problem, and of detachment from the environment in the course of solving mnemonic problems.

247.

AUTHOR: Parachev, A. M.

ORG: none

TITLE: Structural analysis of problems

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 111-112

TOPIC TAGS: behavior pattern, mathematic model

ABSTRACT: A hierarchy of structural units in the organization of behavior corresponds to a hierarchy of relationships in the world of problems. The structure of the world of problems is determined by interproblem and intraproblem relationships. Interproblem relationships include the dynamic aspect described by the theory of random processes, and the statistical aspect described by logical calculations and set theory. The structure of intraproblem relationships reduces to the internal structure of a problem described in the language of graphs. The internal, or labyrinth, structure of a problem has an actual and a constructional form of representation. The actual representation serves as a basis for description of total regulator mechanisms which solve a system of universal metaproblems. The labyrinth structure is defined in the constructional representation as areas and transitions between them. Two-component descriptions of the areas accepted in psychology reduce to three-component descriptions, which prove productive in neurocybernetic research.

248.

AUTHOR: Parachev, A. M.; Starinets, V. S.

ORG: none

TITLE: A question on the structural organization of behavior

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 112

TOPIC TAGS: behavior simulation, learning theory, behavior pattern, metamathematics

ABSTRACT: A system for behavior regulation has five subsystems grouped in three levels: 1) "body" and "emotion"; 2) "operation" and "information"; and, 3) "assimilation." Interaction between subsystems is accomplished according to the principle of dynamic hierarchy. The hierarchic totality of problems develops in three directions: informational, operational, and descriptive. The role of examples in individual and collective learning and of assimilation of relationships between objects and processes of the environment during formation of operational systems is examined in the semiotic totality of problems.

249.

AUTHORS: Pavlova, L. P.; Lomenenko, A. F.; Sergeyev, G. A.

ORG: none

TITLE: Statistical methods for studying reliability mechanisms of the human brain

SOURCE: AN SSSR. Nauchnyy sovet po kompleksnoy probleme "Kibernetika". Voprosy bioniki (Problems of bionics). Moscow, Izd-vo "Nauka", 1967, 154-162

TOPIC TAGS: bionics, cybernetics, biologic model, mathematic model, correlation statistics, brain, reliability, neuron, autocorrelation function, correlation function

ABSTRACT: The construction of an adequate information model of the human brain is discussed. It is felt that hypotheses that simultaneously take into account the determinant and probabilistic characteristics should be used. A model in the form of a multivariate nonstationary dynamic system must take into account the individual discrete states reflected by redistribution in time and space coordinates of the local centers of electrical activity. Electroencephalograms are used to determine the degree of electrical activity, by statistical processing on an M-20 computer. It is found that the allowable level of reliability can be given in the form of a matrix of the relative parameters of nonlinearity of sections of the brain in various phases of its operation. A definite correlation is found between levels of nonlinear EEG distortions in various parts of the frequency spectrum. The number of structural couplings varies in logarithmic scale as a linear function of the number of centering channels used.

Orig. art. has: 12 formulas, 3 figures, and 1 table.

250.

AUTHOR: Peymer, I. A.

ORG: none

TITLE: A question of mechanisms of the integrating activity of the brain on perception of and reaction to complex stimuli

SOURCE: Vsesoyuznaya konferentsiya po neyrocybernetike, 3d. Rostov-on-Don, 1967. Problemy neyrocybernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 112-113

TOPIC TAGS: brain, biopotential, animal, cerebral cortex, biologic model, computer simulation

ABSTRACT: Induced potentials of the human brain were studied during perception of and reaction to complex stimuli by recording them as successive polyphase electric potentials changing in slope and expressiveness of phase depending on the amount of information in the signal. A characteristic alternation of local and generalized

electric brain reactions in which each local or generalized reaction is distinguished by sign and territory from the preceding one was discovered by investigating the correlation function of individual phases of induced potentials in various regions of the brain. Similar cycles of local and generalized reactions recurred until a response was obtained and the problem was solved. Experiments on animals with permanently implanted electrodes allow the supposition that the cerebral cortex and a group of its subcortical structures interact to accomplish similar cyclic reactions. The author attempted to simulate this process on computers, and established a hypothesis on brain mechanisms which accomplish similar reactions.

251.

AUTHOR: Plotnikov, V. V.

ORG: none

TITLE: On mechanisms of selectivity in cognitive processes

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 114-115

TOPIC TAGS: psychopathology, psychometry, probability, mental disorder, behavior pattern

ABSTRACT: Schizophrenics were examined with different psychological tests, in which some revealed a tendency to equate probabilities of utilization of important and unimportant information when there was no reduction of the formal level of psychic functioning. Reaction time to light signals presented with different probability, the relationship of the reaction time to the number of alternative choices, and learning probabilities on the basis of prolonged learning were investigated in healthy subjects and schizophrenics. A special method was applied to determine whether the probability of signal appearance in a previous experiment is the determining factor of choice. Results confirm the presence in man of two interdependent probability models of the surrounding world (Bernshteyn, Bruner). The capacity for creating a realistic probability model of the surrounding world is not disturbed in schizophrenics, but their capacity for evaluating the significance of objects is disturbed. A realistic model of the probabilities of events in the surrounding world never determines behavior by itself. Behavior is determined only by problems of activity or by the significance of their constituent objects. The mobilizing effect of a problem on present action is weakened and the inclination to activity is reduced or absent in schizophrenics.

322.

AUTHOR: Pospelov, D. A.

CRC: none

TITLE: Problems of psychonics

SOURCE: AN SSSR. Nauchnyy sovet po kompleksnoy probleme "Kibernetika". Voprosy bioniki (Problems of bionics) Moscow, Izd-vo "Nauka", 1967, 294-297

TOPIC TAGS: bionics, personality integration, decision theory, environment simulation

ABSTRACT: The term psychonics is defined as the science of investigating the psychic activity of man and animals for the purpose of utilizing the results in planning technological systems. The paper considers the basic problems of psychonics which have to be solved before technological systems capable of solving complex logical problems can be created. The three most important problems of psychonics are discussed: creation of an external environment model in a machine, decision making, and modeling of personality. One of the greatest difficulties in creating an external environment model is that external signals have to be coded in a language that is meaningful in relation to the synthesizing system. The problem of making decisions on the basis of certain optimality criteria is the most popular subject of experimental study. Approaches to the theory of decision making include the theory of statistical decisions, game theory and some theories of conflicting situations. Work on creation of artificial personalities such as ALDOS conducted in the United States and EMIK in the SSSR shows that programs of this type suffer from a lack of serious studies on the psychology of the personality. Development of a personality theory has a practical application in designing control systems which could have a certain "subjectivity" in solving problems, especially in conflict situations. From an engineering point of view, problems involved in the psychology of a collective and its structural formation are of great interest because of the eventual simultaneous functioning of groups of systems having a certain degree of "free will".

253.

AUTHOR: Pragina, L. L.

ORG: none

TITLE: Investigation of algorithms for one class of form recognition

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 123

TOPIC TAGS: algorithm, form recognition

ABSTRACT: Basic complexes of limitations typical of the external environment surrounding man must be selected to develop appropriate algorithms for recognition and to establish special search tactics corresponding to each complex. It is impossible to create one universal general program for all cases of recognition, and at the same time creating special programs is inefficient. Several of the most typical classes of information problems in recognition, for which appropriate complexes of limitations were developed, were formally described in the work. Methods worked out for developing algorithms were a variation of experiments on formalized models of information situations. The algorithms developed and their theoretical examination were described, and preliminary results of simulating one of the algorithms for form recognition were presented.

254.

AUTHOR: Pushkin, V. N.

ORG: none

TITLE: Problem of neuron functioning in an heuristic automaton

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 125-126

TOPIC TAGS: neuron, automaton, heuristic automaton, biologic model, genetics, thought process

ABSTRACT: The modern theory of automata which is basic to the construction and analysis of cybernetic systems can be characterized as a stimulation-reaction theory. A stimulation-reaction automaton must have clearly defined stimuli and must accommodate the number of internal states of possible stimuli. Such an automaton can guarantee behavior in an environment of separate elements by sorting variants and by passage through the labyrinth. An automaton based on the stimulation-reaction theory cannot successfully solve labyrinth problems whose finite area lies in space with an indefinite number of measurements (creative problems). Some principles of a theory of heuristic automata were proposed based on experimental investigation of human

creative thought. These automata can solve extrapolation problems with an indeterminate range of search. Construction of models of objects from the external world is an essential feature of heuristic automata. The function of neurons as units for construction of cybernetic systems was thoroughly analyzed. The theory of neuron networks is limited in its simulating possibilities and corresponds only to the stimulation-reaction theory of automata. A neuron of an heuristic automaton should reflect the dynamic characteristics of the problem. Investigations in genetics and molecular biology allow the supposition that the conditions of a problem are coded in an heuristic automaton according to the principles of formation of genetic models in chromosomes and that the model of an object from the external world is similar to the chromosome genetic model. This hypothesis makes it possible to examine the process of creative thought, which is expressed in the creation of new models, by analogy with the process of mutation of the genetic code.

255.

#### INTRACORTICAL AUTOMATIC REGULATION AND HUMAN HEURISTIC ACTIVITY

ORG: Institute of Psychology, Academy of Pedagogical Sciences  
of the RSFSR, Moscow (Institut psichologii APN RSFSR)

Pushkin, V. N., and Yu. M. Lopushikhina. Mezhvuzovskaya nauchnaya konferentsiya po neyrokibernetike, 2d, Rostov-on-Don, 1965. Problemy neyrokibernetiki (Problems of neurocybernetics); materialy konferentsii, v. 2. Rostov-on-Don, Izd-vo Rostovskogo univ., 1966, 251-254.

AT7033554

The term "heuristics" has two connotations — the individual's attitude," which reduces the extent of decisions, and a certain activity in the individual which results in the formation of "attitudes" and methods of action under new conditions.

Chess-playing material was used in this study. The movement of the subject's eyes was recorded as he surveyed and analyzed a complex position in the game. It was concluded that the core of this heuristic activity is the formation of systems from a totality of elements, i.e., a simulation of the positions by the chess-player.

A chess board measuring 80 x 80 cm, was placed at a distance of 1.5 m from the subject. The subject's head was secured by special equipment. His eye was filmed and the position and direction of the pupil was determined by its center. Then, a frame-by-frame evaluation of this material gave a picture of the eyes' tracing movements over the configuration of the board. It was very interesting that, after the initial fixation of the eye on a certain square of the board, subsequent eye movement was expeditious, i.e., a certain strategy in the movement of the eye towards more important elements of the configuration was already noticeable.

The average length of visual fixation on a given point was 0.24 sec for the subjects; in this short period the subject was able to reflect repeatedly the situation and form strategy for further eye movement. In order to obtain more distinct results the subject was asked to look at the board for 10 sec.

It turned out that there is a certain activity which determines the examination of a problem which the subject is not aware of; it occurs in a negligible amount of time. In a control experiment, consisting of remembering the positions, the subject's eye would feel out practically all the areas of action and all the elements of the situation, but would not show the above-mentioned expeditious movement. The author feels that this brief moment of expeditious movement is significant and is a component of heuristic activity. There exists, evidently, a regulation of the collection of information concerning the conditions of the problem although the individual is unaware of this regulation.

The example of Mendeleev making a discovery in a dream, seemingly without directed activity, is considered. The authors believe this is similar to psychological insight.

Insight was quite obvious in the experiments of Keller: an ape, after an unsuccessful attempt to solve a problem, sat down for a while as if thinking — then suddenly and unexpectedly solved it correctly, obtaining the banana. Insight is a very important unexplored phenomenon in psychology and in the physiology of the higher nervous system. Attempts to explain this unconscious component of creative activity have produced no substantial results.

There has been a tendency in the field of cybernetics to regard the brain as a system modeling the outside world. One can imagine an individual attempting to solve a problem. He sets up in his mind a model of the problem. This model then is able, autonomously and without any application of the individual's will and awareness, to continue working and then later suddenly to give results. This unconscious activity, consequently, may then be defined as autonomous functioning of the dynamic information model of a given problem.

A wide range of experimental facts leads to the following conclusion: the cortex may be conceived as a regulator of the organism and of the organism's behavior in external surroundings, or as a self-regulating unit of the system. It is thus a controlled object which is a set of models of the external world. There is also an intracortical regulator which governs the individual's processing of external phenomena. When these phenomena are reflected a second time in this intracortical regulator — conscious activity occurs. When the model is not within the regulator there is no perception. Therefore, the process of perception is the interaction of the regulator and the cortical controlled objects.

If a problem is being solved in the regulator in the code of intracortical regulation, the result cannot be understood until it has been developed within the models and the interaction of the regulator and the controlled object has begun. Thinking activity outside of this process cannot be perceived. This is the hypothesis which the author wishes to advance, and it is confirmed by evidence of the following types: 1) the purely anatomical data on the frontal lobe and its interaction with other parts of the brain; 2) Clinical-neurological aspects (such as the results of a frontal lobotomy — the regulation weakens, i.e., the regulator has no code).

Another interesting aspect is that, if a schizophrenic's regulator functions in excess, (he sees too many problems), after a lobotomy, all intellectual activity disappears entirely. [AC]

256.

AUTHOR: Reznik, A. M.

ORG: none

TITLE: An a priori statistic approach to investigating algorithms of the brain

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 129-130

TOPIC TAGS: brain, algorithm, neuron, probability, statistic analysis, human sense

ABSTRACT: The basic difficulty in investigating algorithms for the work of the brain lies in inadequate mathematic apparatus for the specific structural organization of neuron ensembles. A method for overcoming this difficulty based on an a priori statistical approach to analysis of brain activity was examined. It was supposed that a living organism realizes a certain optimal algorithm which ensures maximal probability of survival in the surrounding environment. The probability of survival is steadily diminished with increase in the delay time of reaction to a stimulus caused by increase in the number of operations completed by the organism in the process of response formation. It was demonstrated that the optimal algorithm, under these assumptions, consists of a multistage procedure of accepting partial solutions based on analysis of the individual elements of the stimulus and their combinations. Conversion of the stimulus into the reaction can be represented as a sequence of local-compact transformations which convert elements of the space of the stimuli into the space of reactions. In such a form the optimal algorithm essentially describes the structural organization of the neuron network of brain sensory systems. In this organization the functions of accepting partial solutions in the neuron network rest on individual neurons and their ensembles. A conclusion was formed about the feasibility of an a priori statistic approach to the analysis and synthesis of algorithms which describe nervous activity both on the neuron level and on the level of the entire organism.

257.

AUTHOR: Rusinov, V. S.; Grindel', O. M.; Boldyreva, G. N.; Gnezditskiy, V. V.

ORG: none

TITLE: Space-time relationships of the electric activity of the normal human brain and the brain with focal injuries, based on correlation and spectral analysis of EEG data

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 131-132

TOPIC TAGS: brain, EEG, bioelectric phenomenon, injury, cerebral cortex, reflex activity

ABSTRACT: The space-time relationships of electric processes in the cortex of the large hemispheres is of interest for understanding the joint work of various sections of the brain in the course of reflex activity. Autocorrelation and spectral analysis of the EEG of healthy persons demonstrated the diversity of the spectra and the varied expressiveness of general frequency components by regions of the cortex. Two forms of connections between regions of the cortex were detected by EEG cross-correlation. One form displayed the predominance of a periodic component with time shifts and the other displayed the predominance of a random component without time shifts. It was demonstrated that cross-correlograms of various regions in the cortex of healthy persons are characterized by specific features. Under afferent stimulation the nature of EEG correlation functions and the time relationships of the rhythms change in various ways depending on the modality of the stimulation applied. In the case of focal injuries of the brain, changes were obtained in the spectra and in the EEG correlation functions of various regions of the cortex. A relationship between the nature of changes in the cross-correlation function and the nature of a feature in the clinical manifestation of local injury was established in a number of cases for focal injuries.

258.

AUTHOR: Schedrovitskiy, L. P.

ORG: none

TITLE: Some investigation concepts and principles of long term memory

SOURCE: AN SSSR. Nauchnyy sovet po kompleksnoy probleme "Kibernetika". Voprosy bioniki (Problems of bionics) Moscow, Izd-vo "Nauka", 1967, 224-226

TOPIC TAGS: human memory, experimental psychology

ABSTRACT: G. A. Miller (1956) in his works shows that the volume of direct memory is not dependent on the amount of information presented in the material. But, P. B. Nevel'skiy (1957) in staging some of the experiments described by Miller draws different conclusions, namely, that the memorizing process depends on the amount of information presented. The author analyzes in detail the experiments as staged by Nevel'skiy and shows that he did not fulfill the basic requirement of using the same number of symbols in comparing material for memorization. For example, the following two sequences of three digit numbers the author does not consider comparable, though both contain eight sets of three digit numbers:

246	579	246	579	246	579	579	579
112	342	957	608	632	441	818	792

According to Miller's reasoning the two sequences are not actually of the same length. The first sequence really presents less than eight elements for memorization, and the second sequence is closer to twenty-four elements. Experiments staged by the author confirmed Miller's hypothesis that the amount of information does not determine the memorization process. The author also disproves Nevel'skiy's contention that memory volume can be measured by the ratio between the mean values of the number of symbols and the number of repeated presentations of the material. A concept of long term memory volume, as a ratio between the number of stimuli in a sequence or the amount of information and the number of repetitions or presentations, assumes that the memorization process is a uniform steady process consisting of the same operations and is completely determined by the number of times the material is repeated. Such a concept does not take into account the actual nature of the material and the mnemonic activity of the subject, and changes the study approach from subjective psychic activity to an objective quantitative approach.

250.

AUTHOR: Semanova, T. P.; Ignat'yeva, D. A.; Zykov, M. B.

ORG: none

TITLE: Investigation of algorithms for decoding the black box

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 136-137

TOPIC TAGS: algorithm, human memory, learning process, brain

ABSTRACT: A procedure is proposed for study of algorithms usable by man in decoding the black box. This makes it possible to balance problem complexity with requirements on the subject's memory. The logical problems used in the procedure are solved by clear mathematic algorithms with different degrees of complexity. Several types of work using the black box procedure are possible: a) determination of the maximal complexity of problems which can be solved by the subject under conditions of different external stimulation; b) determination of the effect of the penetration of disciplines at various levels of learning on the capacity to recognize the black box function; and, c) study of algorithms for human brain activity used in decoding the black box. An analogy is developed in the work between operating with a black box and problem solution in various investigatory situations.

260.

AUTHOR: Sergeyev, G. A.; Pavlova, L. P.; Prodan, V. T.

ORG: none

TITLE: Frequency characteristics of electroencephalograms of the active human brain

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 137

TOPIC TAGS: EEG, brain, thought process, emotion, analog method, man

ABSTRACT: An analog method of EEG processing was investigated which was based on two automatic recording devices and an electronic transformer that transformed the EEG amplitude into an instantaneous spectrum. The feed mechanism of one recorder was used as a simulating device and the chart of the initial EEG was reproduced on its tape. This EEG was copied from the electroencephalograph tape. The difference in values between the present phase of the EEG and the phase of a certain reference voltage was reproduced by manual outlining of the EEG on the electronic device. This parameter reflects the degree of asymmetry of the EEG phase for different levels of the functional condition of the brain. It was established that activation of the brain in the process of human emotional excitation is expressed in the form of increase in the mean level of the spectrum to six db. The method developed can be used to investigate the degree of activation of different sections of the brain in performing intense mental work.

261.

A CONCEPTUAL PHYSIOLOGIC MODEL OF THE BRAIN OF HIGHER ANIMALS AND MAN

**ORG:** Scientific Research Institute of Neurology and Psychiatry,  
Kharkov (Nauchno-issledovatel'skiy institut nevrologii i  
psikiatrii)

Shogam, A. N. Soveshchaniye po problemam vysshey nervnoy deyatel'nosti,  
21st, 1966. Tezisy i referaty dokladov. Moscow, Izd-vo "Nauka," 1966,  
333-334.

AT7024100

The conceptual model of the brain presented is based on an analysis of the author's data on the physiology of constructive actions and motor skills of man and animals. The model consists of four rows of units. The first row of units, representing a switching and control mechanism related to the frontal parts of the brain, is the most important mechanism of self-programming and activity in man and animals. The second row of units, representing phylogenetic and ontogenetic experience programs, consists of specialized analyzers (specialized subcortical mechanisms and two cortical signal systems). The third row of units represents apparatus for tracing, evaluating, and correcting in the form of three levels of acceptors. The fourth row of units represents dynamogenesis of the neocortex and localized mechanisms of activation, including parts of the stem and cortex. Instead of a reticular activating system, it is more correct to speak of a complex activating system controlled by the switching unit of the frontotemporal cortex. The basic unconditioned reflex structures participating in dynamogenesis and in the mechanisms of self-programming by formation of new temporary connections are the unconditioned reflexes of orientation and survival. The orientation reflex is the source of microergic dynamogenesis for forming afferent conditioned reflex connections, and the survival reflex is the source of microergic dynamogenesis for developing new motor skills. These two unconditioned reflexes form the two basic "servomechanisms" of the model, input and output.

[06]

262.

AUTHOR: Sitkovskiy, A. I.; Uvarov, A. Yu.

ORG: none

TITLE: An heuristic learning model in formal environments

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 138

TOPIC TAGS: heuristic model, learning process, biologic model

ABSTRACT: In the human learning model examined, the external environment for a given object was represented in the form of a totality comprised of a set of states of the information field and of a set of actions of the object. Dynamic properties of the environment were defined by functional correspondence determined by a set of sequences with a range of values for the set of states of the information field. Methods were given for defining the sets by a set of significant variables and significant actions, and for defining a functional correspondence in the form of a set of operators and the functions determined for this set. Environments which have formal representation were preliminarily classified. A fixed class, called a "moronic" one, and a subclass of "moronic" environments were distinguished by conditions which limit the strength of the real part and by conditions of applicability of the operators. A program was formulated on a computer which simulates learning in this class. Learning by man was compared with learning by the program, and one criterion for comparing the two learning processes was considered.

263.

AUTHOR: Talayev, S. A.

ORG: none

TITLE: A model of purposeful behavior

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 144-145

TOPIC TAGS: behavior simulation, computer simulation, heuristic programming, emotion, thought process, biologic model

ABSTRACT: The proposed model is part of a general heuristic model of purposeful behavior developed in accordance with N. M. Amosov's hypothesis on the simulation of thought. The model functions in a conditional external environment representing a set of elementary sections of a locality. In each section there are "objects", and the reaction to their presence and significance determines the behavior of the model. The elements needed to simulate this behavior are a choice of purpose, construction of an internal model of the external environment, and a plan for attaining the purpose. The model is a system which processes information in logical, emotional and motor spheres organized in levels. Integral evaluations of the emotional sphere are the criteria for construction of a surface of potentials of "desires" in the internal model, in accordance with which multilevel plans of behavior are constructed. The model was realized in the form of a digital computer program.

264.

AUTHOR: Telegina, Z. D.

ORG: none

TITLE: Analysis of the relationship of means to purpose in the heuristics of man and machine

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 145-146

TOPIC TAGS: heuristics, behavior simulation, man machine system, game theory

ABSTRACT: The mental activity of chess playing was investigated by recording movements of subjects' eyes. Analysis revealed a number of heuristic procedures used by man for reduction of search. One heuristic procedure, analysis of the relation of

means to purpose, was simulated to reveal the actual processes realized during its use by man for problem solving and program input. The basic feature of the given heuristic procedure in human thought is that a specific purpose of human action, as a criterion for choice, is in a specific situation. These purposes can be qualitatively different depending on their origin and their effect on subsequent activity. A purpose can occur as a formed requirement for further actions and as an hypothesis of solution requiring the realization of specific actions. Specific actions establishing the relationship between formed requirements are the means for attaining purpose. Purpose and means are relative. A specific action (a move) can perform the purpose function in a subsequent stage. Thus one method of formation of purpose is the transformation of means into purpose. However, existing heuristic chess programs have purposes fixed in the program which were set before the beginning of the game and do not change in the course of play. The heuristics of analysis of the relationships of means to purpose in the work of machines and in human intellectual activity do not coincide.

205.

AUTHOR: Tikhomirov, O. K.; Fugel'zang, Yu. Ye.

ORG: MGU, Moscow (NGU)

TITLE: Emotional conditions as a component of heuristics

SOURCE: Nezhvuzovskaya nauchnaya konferentsiya po neyrokibernetike, 2d, Rostov-on-Don, 1965. Problemy neyrokibernetiki (Problems of neurocybernetics); materialy konferentsii, v. 2. Rostov-on-Don, Izd-vo Rostovskogo univ., 1966, 267-270

TOPIC TAGS: emotion, intelligence, galvanic skin response, bionics, human memory

ABSTRACT: A study was made to explain the function of emotional conditions arising during the working of intellectual problems, and to determine their relationship to factors limiting the search in solving mental problems. For the study, chess players were presented with problems of selecting the best moves in chess positions. Change in electrical resistance of the skin was recorded as index of emotional reactions. The subject players, upon receiving their assignment, gave verbal accounts of their thoughts while solving the problem. Coincidence of sharp change in skin resistance with moment of problem assignment confirmed assumption that rapid drop in skin resistance is due to development of emotional conditions in the subject. Comparison of verbal recordings and skin resistance dynamics showed little change in resistance

when subject could not see a solution to the problem or when he had an idea he considered of little value, but a drop in resistance when a "good" idea occurred. Thus development of emotional state is related to the development, during the course of mental activity, of new previously unnoticed information or of new mode of action. The time interval between initial development of idea or action and final solution of problem is characterized by sharp changes in the resistance curve when variants are considered. Differentiation in the stages of initial emotional and final rational evaluation of the course indicates that there exists a special selection mechanism which regulates the direction of the operation of the "calculating" mechanism. Emotional evaluations determine the area of subsequent search. Once emotional evaluations fulfill the function of selection, narrowing the field of search, and regulating its direction, they should be directed to the category of heuristics—that which limits the search in the area of a larger number of possibilities. Orig. art. has: 1 figure.

266.

AUTHOR: Tikhomirov, O. K.; Vinogradov, Yu. Ye.

ORG: none

TITLE: Emotions in an heuristic function

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 148-149

TOPIC TAGS: emotion, heuristic, thought process

ABSTRACT: Experimental investigation of emotional states during solution of intellectual problems demonstrated a sufficiently clear relation between states of emotional activation and choice of a basic principle for problem solution. Analysis of this relation demonstrated that states of emotional activation are part of the process of search for a solution. A state of emotional activation acts as a certain nonspecific signal for "stopping" and as a nonspecific anticipation of the principle of solution (or of final solution). Finding the principle of solution of a problem has two phases, selection of an approximate region and then the finding of the principle itself. Emotional activation determines the subjective value of a direction of search. With the appearance of a need for information search, emotions do not simply substitute or compensate but regulate the course of search itself. Emotions are not generators of random solutions but act as a factor in directing the search. Fixation of the search zone, decrease of its size, and change in the nature of search actions occur under the influence of emotional activation. The data obtained demonstrate that the emotions fulfill heuristic functions in solving complex intellectual problems.

267.

AUTHOR: Trofimov, A. N.

ORG: none

TITLE: Heuristic self learning program for one class of information situations

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 150

TOPIC TAGS: heuristic programming, self organization, learning process, human memory, biologic model

ABSTRACT: Typical conditions for self learning of living organisms were distinguished and an heuristic self learning program was created. The learning environment was represented as deterministic with stable cause and effect relationships. A set of limitations determined the appearance and disappearance of signals. Signals of the conditional inhibitor type were assumed present, which prohibited attainment of purposes such as obtaining water or food. The self learning problem consisted of forming a structure in the memory reflecting the regularities of the external environment. The presence of this structure made it possible to form a plan of action for attainment of the purpose in any situation. Simulation was carried out, demonstrating the effectiveness of the program's work under specific conditions.

268.

AUTHOR: Uteush, E. V.

ORG: none

TITLE: Some problems of investigating short term memory

SOURCE: AN SSSR. Nauchnyy sovet po kompleksnoy probleme "Kibernetika". Voprosy bioniki (Problems of bionics) Moscow, Izd-vo "Nauka", 1967, 238-240

TOPIC TAGS: human memory, computer memory, biologic model

ABSTRACT: The development of computers with memory functions carried out by a complex of memory units indicates that the concept of dividing biological memory only into short term and long term memory is unsatisfactory. By analyzing the forms of computer memory, possibly comparable forms can be found in biological memory. The computer memory consists of an operational memory, external memory, long term memory and a buffer memory known as instant memory. The latter type of memory is directly connected with the external organs (speech and auditory apparatuses) and belongs to the class of memory units with variable time of information storage and memory erasure. On the basis of classifying biologic memory (see Fig. 1) according to information storage time and having characterized buffer memory as instant memory, a possible model of human biologic memory can be represented as shown (see Fig. 2).

This model does not show the control devices and instant memory enters a closed line designated as: instant memory--speech--hearing--instant memory. In this model information erasure and possibly the read out from the instant memory takes place only after compensation of the signal in the instant memory, at which time the difference of signals from the direct and feedback lines is sufficiently small or is equal to zero. Only with such a mechanism can the capacity of instant memory be minimal. The capacity of instant memory largely depends on the individual characteristics of an object and the time delay in the direct and feedback lines. With time delays equal to zero, the required capacity is smallest. But, with increase in time delay, instant memory capacity grows; and, with a long time delay, the capacity may not be adequate and normal functioning of the model may be impaired. Echo perception of man is connected with the instant memory structure of the brain. An echo appears following a time delay of 0 to 0.1 sec and is not perceived as a separate sound. Apparently, this time delay is characteristic of instant memory, but long time delays during perception affect the action mechanism of instant memory. Orig. art. has: 2 figures.

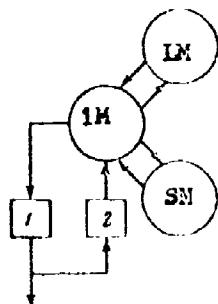


Fig. 1. Diagram of human biologic memory.

LM--long term memory;  
SM--short term memory;  
IM--instant memory  
1--speech apparatus;  
2--auditory apparatus.

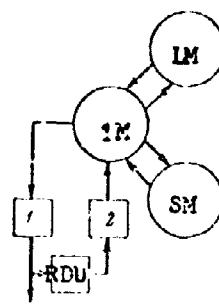


Fig. 2. Diagram of bionic investigations of instant memory.

LM--long term memory;  
SM--short term memory;  
IM--instant memory;  
1--speech apparatus;  
2--auditory apparatus;  
RDU--regulated delay unit.

20..

AUTHORS: Vaynsbord, L. ...; Kozenshteyn, G. Sh.

ORG: none

TITLE: Unstable automata and models of active behavior

SOURCE: AN SSSR. Nauchnyy sovet po kompleksnoy probleme "Kibernetika". Voprosy bioniki (Problems of bionics) Moscow, Izd-vo "Nauka", 1967, 292-294

TOPIC TAGS: bionics, cybernetics, automation, automatic machine, mathematic model, biologic model, mathematic matrix, function, probability, homeostasis, probabilistic automaton, reliability theory

ABSTRACT: An unstable system is considered as a model of a biologic control system. It is found possible to solve various problems of the behavior of unstable stochastic automata that have a natural interpretation in terms of the existence of living organisms. Given matrices  $P(S)$ , it is required to find a function  $r(i)$  such that the life of the unstable automaton is maximal. Extensions of this problem that have been solved earlier are described. A problem of homeostatic behavior of an unstable automaton is given, in which it is required to find an output function  $r(i)$ , where  $i$  is the state of the automaton, such that the probability of falling into an absorbing state before falling into a preferred subset is minimal. Problems of behavior are converted to the language of reliability theory. Orig. art. has: 3 formulas.

270.

#### MODELING OF UNEXPECTED SITUATIONS AND INVESTIGATION OF REACTIONS WITH A KINOREFLEXOMETER

Verkhalo, Yu. N. Soveshchaniye po problemam vysshey nervnoy deyatel'nosti, 21st, 1966. Tezisy i referaty dokladov. Moscow, Izd-vo "Nauka," 1966. 73-74.

AT7024083

In many professional occupations, complex situations require a correct choice of action. The motor problem (response reaction to a given situation) is often difficult and requires previous experience to evaluate the current situation. However, development of a successful program of action in microintervals of time is possible only with long practice. To reduce the time necessary for acquiring such experience, modeling of expected and unexpected situations on film is proposed. With the use of a kinoreflexometer, situations can be reconstructed by programming the visual and acoustic stimuli on a film with a soundtrack. Special markings on certain film frames can automatically switch on recording equipment (chronometric or chronographic) as the frames pass through the projector. The subject can respond to the situation by applying the proper controls on a panel in front of him, and in some cases the situation can be changed in relation to time or direction.

[06]

271.

#### EEG ANALYSIS

ORG: Physiological Institute of Prague, ChSSR (Fiziologicheskiy institut Praga, ChSSR)

Veys, T. Mezhvuzovskaya nauchnaya konferentsiya po neyrokibernetike, 2d, Rostov-on-Don, 1965 Problemy neyrokibernetiki (Problems of neurocybernetics); materialy konferentsii, v. 2, Rostov-on-Don, Izd-vo Rostovskogo univ., 1966, 132-135. AT7033544

The new cybernetic methods have not yet been useful in experimental study of brain activity, but they have shed new light on the evaluation of the results of stimulus-reaction-type experiments. Experiments of this type, including Pavlov's method of studying the central nervous system, reveal some general principles of NS function, but the specific mechanisms of these activities remain unknown. The results of research on the "black box," the brain, are of only hypothetical value. The electrophysiological methods permit the recording of bioelectrical processes ranging from activity on the intracellular level to complex brain activities. The difficulty of evaluating these data lies in the abundance and complexity of information; it is also difficult to determine which parts of the recording are most important. Even an EEG made with many leads and analyzed by the best methods does not always reveal the most important activities of the CNS. For example, a good correlation between activity and the EEG exists during the transition from wakefulness to sleep or during awakening, but the use of certain drugs can give a false picture: atropine with cocaine produces waves typical of the telencephalic sleep phase, and eserine, of the thombencephalic phase. Sleep or narcosis after functional decortication is not reflected in the EEG. EEG's of the same type can be obtained from different parts of the brain, or from different animals in normal or pathological conditions. The EEG of a frog after an experimental shock producing an epileptic seizure does not differ from the human alpha rhythm. Correlational and spectral analyses also do not give a full interpretation of EEG. EEG's which have identical correlograms differ in amplitude histograms. During sleep, which consists of 3 phases, considerable changes in activity take place in the cortex, but they are imperceptible in the mathematical analysis of EEG. Spectral analysis of the EEG clearly shows a peak in the region of the low-frequency spectrum. During awakening, the spectrogram flattens and becomes similar to that of white noise. The functional conditions in the beginning and termination of sleep are very different, but the spectrograms do not indicate it. No methods of analyzing a portion of EEG immediately preceding a change of activities during the onset of sleep can show a change. The EEG is related to complex processes which take place on the synaptic level, but it has no connection with the transmission of information or the conduction of impulses, as indicated by microphysiological research and other data. The importance of the EEG is certainly recognized, but it should be evaluated very cautiously. [EF]

INFORMATIONAL VALUE OF THE EEG

ORG: Physiological Institute of Prague, ChSSR (Fiziologicheskiy institut Praga, ChSSR)

Veys, T. Mezhvuzovskaya nauchnaya konferentsiya po neyrokibernetike, 2d, Rostov-on-Don, 1965. Problemy neyrokibernetiki (Problems of neurocybernetics); materialy konferentsii, v. 2. Rostov-on-Don, Izd-vo Rostovogo univ., 1966, 135-138.

AT7033545

Research on EEG evaluation has been conducted using 10—15-sec-long EEG's recorded on magnetic tape. They were fed into an analog-digital converter, then into the computer, using the principle of digital filtration for the program of Walter and Ashby. For amplitude histograms, the "Ural-2" digital computer and sometimes the amplitude analyzer were used. These methods do not reveal differences in EEG's taken in different situations or originating from brains of different structure. There are three types of correlograms, spectral functions, and amplitude histograms. An analyzed recording is similar either to a modulating harmonic function of amplitudes, or to two close harmonic functions. In the second case, either both harmonic functions modulate together, or the frequency of the basic harmonic vibration varies after the analyzed period. To facilitate the statistical evaluation of correlograms, an approximation of the concrete correlational function can be used. The resulting simplified analytical expression can be characterized by several parameters. By varying these parameters, the correlational functions can be modeled by an analog computer. This method permits the statistical evaluation of larger groups of correlograms, for example 50 of one physiological situation, and 50 of another. A section of the EEG, taken singly, has little value as the EEG is constantly variable from the physiological point of view. Various interpretations are possible for the correlograms of the third type. Such a correlogram can be modeled by the use of the cyclic harmonic functions, their interrelations in various phases, attenuation parameters, and various forms of the constant function component. But these methods do not indicate differences between correlograms and spectrograms in different situations as, for example, the alpha rhythm and the EEG of a frog during an epileptic seizure, because this is a phenomenological approach which does not reveal the internal processes. Physiological experiments prove that a dissociation of EEG and behavior can easily be obtained, just as a certain function without the typical EEG or a typical EEG without the typical function can be. There is no simple linear connection between the brain mechanisms and the EEG, though the logic of many experiments seems to imply it. The EEG indicates clearly the state of sleep and even its phases. During sleep, the cross-correlational function is more pronounced and the cross-spectral functions show better synchronization of the activities of different parts of the brain. The first, or the teleencephalic, sleep phase is characterized by slow waves in the cortex and the hippocampus. The second phase presents a complete desynchronization in the cortex and regular theta activity in the hippocampus. The EEG of the beginning and the end of the rhombencephalic phase shows no

differences, but the animal wakes up in a second or two without any exterior stimulation at the end of the phase, though it needs a strong stimulation to awaken at the outset. But there is no EEG typical of sleep or wakefulness which could not be obtained in another situation by drugs or other means. These outwardly similar EEG's cannot be differentiated. The existing analytical methods are imperfect in two respects. They rely on mean values. A correlogram cannot be done for a period shorter than 10 sec, but if the period lasts longer, the recording varies considerably. The second difficulty lies in the lack of methods for data reduction. Such methods could make possible a statistical evaluation of large groups of EEG's which could be of use to physiologists and clinicians. [EF]

273.

AUTHOR: Zaslavskiy, S. Ya.

ORG: none

TITLE: Heuristic model for solution of problem situations

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 48

TOPIC TAGS: PERT, operations research

ABSTRACT: Intermediate goals of the problem are denoted by a finite number of interlocking points. It is assumed that man knows the problem situation well enough to evaluate transitions from one intermediate goal to another. The set of intermediate and end goals and of possible transitions between them are interpreted in the model as a finite connected and directed graph without contours in which a vertex corresponding to the initial condition and a set of vertexes corresponding to the end goals are fixed. The process of reaching the end goals is reduced to determining one step at a time in situations occurring after each such transition. The analysis necessary for choice of a step is accomplished by weighting each end goal, and then redistributing the weight in succession to all intermediate goals. The difficulty of each possible transition and its motivation characteristics are considered in this redistribution. The step to be performed next is the one leading to the adjacent vertex with the maximum weight.

274.

AUTHORS: Zaslavskiy, S. Yu.; Red'ko, V. N.; Starinets, V. S.; Yushchenko, Ye. L.

ORG: none

TITLE: On a language for modeling psychic functions

SOURCE: AN SSSR. Nauchnyy sovet po kompleksnoy probleme "Kibernetika". Voprosy bioniki (Problems of bionics) Moscow, Izd-vo "Nauka", 1967, 299-304

TOPIC TAGS: bionics, cybernetics, mathematic model, biologic model, algorithm, algorithmic language, machine language, computer language, natural language, computer programming

ABSTRACT: Problems of modeling psychic processes are considered, starting from the level of natural language. Natural language is considered the most clear and adequate reflection of the nature and characteristics of psychic processes. Natural language is converted to a language with a base set and a set of key words (an analytic model of the natural language), to a synthetic model of the latter language, to algorithmic language, and to machine language. The algorithmic language is discussed in detail, and requirements on such specialized languages are described. An expanded address language with a translator in the form of an attachment to existing address-language translators is considered a first approximation to the modeling language. Orig. art. has: 4 formulas.

275.

AUTHOR: Zverev, V. Yu.; Plotnikov, V. N.

ORG: none

TITLE: Heuristic method for reducing the dimensions of a dynamic programming problem

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 49-50

TOPIC TAGS: production engineering, dynamic programming, open hearth furnace

ABSTRACT: The method applies to optimization of control of an open hearth department. The original scheduling methods (strategy) of the department were far from optimal. Idle periods frequently occurred because of irrational arrangement of equipment and difficulty in predicting the course of melting, leading to difficulties in coordinating operations. A method of dynamic programming is used for optimization of control, but the number of control strategies that must be investigated can be so great that the method is useless in practice because of limitations in computer speeds and memories. To reduce the dimensions of the problem, an heuristic rule is introduced to evaluate the condition of the object and possible controls. This rule was determined during study of the work of the department's work scheduler, and it significantly narrows the range of search for control strategies. The effectiveness of the heuristic method is analyzed.

**SECTION D. PROBLEMS OF TRANSMISSION, PROCESSING, AND ENCODING  
OF INFORMATION IN THE LIVING ORGANISM**

**276.**

AUTHOR: Adzhimolayev, T. A.; Durinyan, R. A.; Poshina, I. S.; Grigoryan, L. R.

ORG: none

TITLE: Peripheral coding of proprioceptive information

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967.  
Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov  
konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 4

TOPIC TAGS: algorithm, coding, muscle physiology, proprioception, neurophysiology

ABSTRACT: Experiments were carried out on m. extensor longus digiti IV tension receptors according to a method described by Katz in 1950, to study the conversion of an external signal into a corresponding sensor message, i. e., to determine the algorithm of conversion of a continuous value of external action into an impulse sequence of signals. Results indicate that the work of the tension receptor is a system with sufficiently stable parameters. It is certain that the tension receptor has clearly expressed uncontrolled spontaneous activity with a specific leading function. The frequency of impulses generated by the tension receptor bears a linear relation to the value of absolute elongation of the muscle. The threshold for the emergence of action potentials in the receptor fluctuates within specific limits. With actions controlled at the receptor input, i. e., with tension of the receptor according to sinusoidal, sawtooth, or right-angled laws, the receptor transforms the message obtained into a stream of neural impulses which has a specific structure according to the disturbance transmitted.

277.

AUTHOR: Agababyan, K. G.

ORG: none

TITLE: Coding visual information in neuron structures

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-On-Don, 1967, Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 3-4

TOPIC TAGS: coding, visual simulation, neuron, optic model, biologic model

ABSTRACT: Coding visual information in the peripheral part of the visual analyzer is considered. A proposed model represents a multilayer neuron network based on certain physiological concepts. Both discrete and continuous black-white images can be input signals for the model, which is constructed according to the principle of a "physiological funnel." The model can: a) separate contours of a form; b) determine the magnitude of the angle of inclination of a rectilinear edge of the form relative to the receptor field; c) code the direction and velocity of a moving form; and, d) ensure high reliability of coding both in relation to external noises and in relation to defects of elements in any layer.

278.

AUTHOR: Braynes, A. S.;

ORG: none

TITLE: The role of RNA in memory mechanisms

SOURCE: AN SSSR. Nauchnyy sovet po kompleksnoy probleme "Kibernetika". Voprosy bioniki (Problems of bionics) Moscow, Izd-vo "Nauka", 1967, 240-245

TOPIC TAGS: RNA, human memory, learning process, protein synthesis

ABSTRACT: The article presents a literature survey of mostly American sources on the role of RNA in learning and memory processes. Basically, there are three approaches to the study of RNA and learning processes. The first approach studies the effects of parenteral administration of RNA on the learning of experimental animals. The author feels that this approach contributes very little to the understanding of the molecular bases of memory because the action mechanism of the administered RNA is not clear. The second approach consists of inhibiting either protein or RNA synthesis with the introduction of such substances as RNA-ase, actinomycin D or C or pyromycin. The third approach, represented by the work of Holden Hyden determines the chemical composition and activity of separate brain cells. The author considers this method "a million times more sensitive than the ordinary microchemical methods." On the

basis of years of research, Hyden's work indicates that different types of RNA are synthesized in different phases of learning. In the early stage of learning when a new stimulus excites the neuron genes, a small amount of new RNA rich in adenine and uracil is synthesized. When learning is successfully completed, a ribosomal type of RNA rich in adenine and cytosine is synthesized; this type of RNA is also necessary for neuron functioning. Thus, the learning process is apparently related to synthesis of informational RNA, but the information reinforcement process and physiological stimulation is accompanied by ribosomal RNA synthesis. J. B. Flexner's experiments to determine whether the formation mechanism of memory traces is related to protein synthesis is of interest in relation to Hyden's work. Flexner introduced pyromycin bilaterally into the temporal lobe and frontal lobe and found that long term memory is seriously impaired with protein synthesis inhibition in the hippocampus, temporal lobe and frontal lobe. The author points out that Flexner's data do not contradict Hyden's conclusions. Orig. art. has: 1 table.

279.

AUTHOR: Bykov, K. A.; Funtikov, B. A.

ORG: none

TITLE: Investigation of transitional processes in different links of the visual system of the frog

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. 'Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Postov-on-Don, Izd-vo Rostovskogo univ., 1967, 16-17

TOPIC TAGS: frog, visual activity, electrotoretinography

ABSTRACT: Studies of the processing and transmission of information in sensory systems are mostly concerned with stationary states established in time. However, in actuality the visual system very rarely functions under static conditions. Stimuli received by receptors of the retina are continuously shifted over it and are changed with time. For this reason investigation of transitional processes from one state to another is of interest. Investigation of a reaction in response to two optical stimuli, when the second stimulus follows with a different delay behind the first one, is a specific approximation of these operating conditions of the visual system. The authors studied electric responses of the retina and midbrain to two optic stimuli, tracing the dynamics of responses in relation to the interval between flashes with different parameters of optical stimuli. Such an approach permitted the evaluation of transitional processes of the peripheral and central links of the visual analyzer.

200.

AUTHOR: Furduy, F. I.; Nikitovich, S. N.; Marin, L. P.; Guragata, Ye. N.

ORG: none

TITLE: Participation of different sections of the brain in processing information arriving from the stomach

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 157-158

TOPIC TAGS: brain, homeostasis, dog, information processing, gastrointestinal tract

ABSTRACT: Experiments on dogs with electrodes permanently implanted in various subcortical brain structures in the motor, temporal, and occipital cortical regions of the large hemispheres indicated that different sections of the brain participate in conducting and processing afferent signals from the stomach and the intestine. These sections of the brain form the central component of the functional system that regulates the stomach's activity. The composition of the links of this system is not uniform. It was discovered that such sections of the brain as the hypothalamus, the reticular formation of mesencephalon, the reticular formation of medulla oblongata, and the cortical motor region of the large hemispheres are included in this functional system in certain cases, depending on the quantity and composition of the organism's hormones. Electrocoagulation of certain links of this system in the first days after an operation disturbs homeostasis of the gastric wall, but after one to two weeks homeostasis is reestablished. In other cases, the hippocampus, the limbic cortex, and the thalamus are also functionally joined into this system. Deterministic disturbance of certain links of this functional system had an effect of short duration on the activity of the stomach. Data were presented which indicate the role of certain hormones in the union of different sections of the brain into a functional system regulating homeostasis of the gastric walls.

281.

AUTHOR: Gambaryan, L. S.; Gasparyan, Yu. M.

ORG: Laboratory of Neurobionics, Academy of Sciences ArmSSR  
(Laboratoriya ncyrobioniki, Akademiya nauk ArmSSR)

TITLE: Some problems of information transmission along a nerve fiber

SOURCE: AN SSSR. Doklady, v. 178, no. 3, 1968, 745-747

TOPIC TAGS: nerve fiber, neurophysiology, signal transmission, probability

ABSTRACT: According to the theory of discrete conduction, a nervous impulse carrier of information, generated in a single Ranvier node (RN) is propagated along the fiber by skipping from one Ranvier node to another. With such organization of impulse conductibn, the probability of information transmission along the fiber is determined by the degree of functional readiness displayed by the Ranvier nodes. Experimentally it has been shown that even with blocking of two or more Ranvier nodes, the nervous impulse can skip over these contiguous unexcitable nodes. On the basis of these data, the problem of information transmission probability is considered. The problem is formed in the following manner. Let the nerve fiber have N RN, and let the minimal number of contiguous blocked RN over which the nerve impulse cannot skip be equal to r. It is assumed that an RN can be found in only two states: state A when the RN is not blocked, and state B when the RN is blocked. Let the probability that an RN is in state A equal P, and the probability that the RN is in state B equal q = 1-P. A nervous impulse entering a fiber can be propagated to the termination of the fiber if  $m < r$ , where m is the number of contiguous blocked RN. Evaluation of fiber reliability is reduced to calculating the probability  $P(N)$  of the event not taking place, at the same time when  $m \geq r$  contiguous RN will be blocked. The mathematical interpretation of the problem is reduced to finding probability  $P(N)$  of the nonappearance of  $m \geq r$  contiguous "failures" in repeated independent Bernoulli tests. Probability of "success" is equal to P and "failure" to q = 1-P. The probability to be found is determined by the following:

$$P(N) = \begin{cases} 1 & \text{with } N < r, \\ 1 - q^r [1 + P(N-r)] & \text{with } r \leq N \leq 2r \\ 1 - q^r \sum_{i=0}^{N_1} a(i) + \sum_{i=1}^{N_2} b(i) & \text{with } N > 2r+1, \end{cases} \quad (1)$$

where  
 $a(i) = (-1)^i C_{N-r(i-1)}^i (Pq^r)^i$ ,  $b(i) = (-1)^i C_{N-ir}^i (Pq^r)^i$ ,  $N_1 = N_r - \frac{r}{r+1}$ ,  $N_2 = \frac{N}{r+1} - 1$ .

A set of curves  $P(N) = f(N)$  with  $r = \text{const}$  and  $P = \text{const}$  is shown (see Fig. 1). Fig. 1d shows that with  $r = 5$  and  $P = 0.9$ ,  $P(N) = 1$  all nervous impulses entering the fiber reach the termination of the fiber with complete reliability. But, from equation (1) it is evident that with  $r = 2 : 5$  and  $N \gg r$  as is found in real nerve fibers, the probability of transmission of a single impulse  $P(N)$  is exceedingly small. However, it is well known that useful information is not carried by a single nervous impulse, but by a bundle of successive impulses. Thus, the reliability of the work of a receptor-fiber system is determined by the probability that with  $n$  impulses successively entering the fiber, at least  $m$  impulses ( $m = 1, 2, \dots, n$ ) will reach the end of the system. In this case the probability of information transmission along the fiber  $P_{n,m}$  will characterize the reliability of the receptor-fiber system and is determined by:  $P_{n,m} = 1 - \sum_{k=0}^{m-1} P_{n,k}$ . (2)

From equation (2) it is evident that  $P_{n,m}$  is directly proportional to  $n$  and inversely proportional to  $m$ . Assuming that  $P(N) = 0.5$ ,  $n = 10$  and  $m = 1$ ; then  $P_{n,m} = 1 - (1 - P(N))^{10} = 0.96875$ . Thus, with a bundle of successive nervous impulses, the probability of information transmission along the receptor-fiber system  $P_{n,m}$  increases sharply. The system proves to be very reliable despite the low reliability of the fiber itself. The paper was presented by Academician P. K. Anokhin on 04 Aug 66. Orig. art. has: 2 formulas and 1 figure.

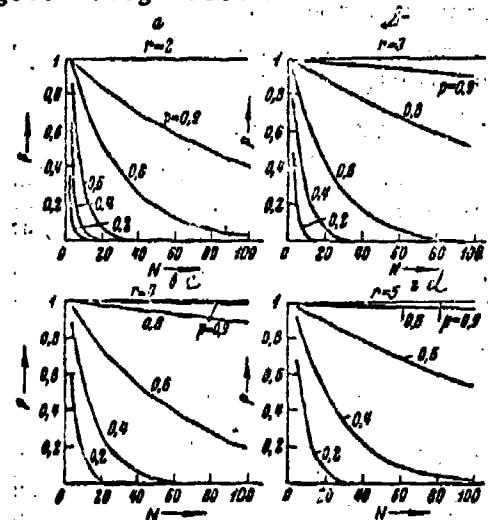


Fig. 1. Dependence of the transmission probability of a single impulse  $P(N)$  along the nerve fiber on the number of Ranvier nodes  $N$  with  $r = \text{const}$  and  $P = \text{const}$ .

AUTHOR: Gamkaryan, L. S.; Gasparyan, Yu. M.

ORG: Neurobionics Laboratory AN Armenian SSR (Laboratoriya nevrobioniki AN Armyanskoy SS.)

TITLE: Certain bionic aspects of the reliability of biological systems

SOURCE: Biologicheskiy zhurnal Armenii, v. 20, no. 4, 1967, 25-34

TOPIC TAGS: bionics, system reliability, brain, nerve fiber, neuron, central nervous system

ABSTRACT: The reliability of information transmission in an organism upon its reaction to its environment, as described by the system environment-receptor-brain-effector-environment, is subjected to mathematical analysis. Considering the nerve impulse as the information carrier, the nerve fiber as the information transfer channel, and propagation along the fiber to be effected by impulses jumping from one Ranvier node to another, the reliability of information transmission is determined by the degree of functional readiness of these interceptors. The mathematical interpretation of the problem by other authors is reviewed, and a formula is developed for approximating the reliability of the nerve fiber, i. e., for calculating the probability  $P(N)$  of the nonoccurrence of simultaneous blocking of adjacent nodes. Since the information carrier is a group of successive impulses  $n$ , and not a single impulse alone, the reliability of the receptor-fiber system will be determined by the probability  $P_{n,m}$  of transmitting  $m$  of the  $n$  impulses to the end of the system:

$$P_{n,m} = 1 - \sum_{k=0}^{n-1} P_{n,k}. \quad (5)$$

Although the probability  $P(N)$  of transmitting a single impulse is small, the specific coding of the external stimulus in the block of successive impulses significantly increases the probability  $P_{n,m}$  of information transfer in the receptor-fiber system. There is discussion of transmission of information via non-myelinated fibers, where an impulse can jump over a blocked section of the fiber if the fiber length exceeds the conductance threshold. Calculations were not made in the absence of experimental data. The reliability of the integrating function of the brain is discussed, recognizing the contribution of the polyanalyser activity of the brain to the increase in the functional reliability of the central nervous system. The polyanalyser principle of the functioning of the brain is analysed using the concept of the formal neuron. The authors concluded, supporting their earlier publication, that if the probability that a neuron will fulfill a given logical function is taken as the criterion for evaluating logical reliability, then the polyanalyser principle and polysensory convergence tend to increase the logical reliability of the neuron. The paper was presented at the XVIII International Congress of Psychologists, 1966. Orig. art. has: 6 figures and 6 equations.

283.

AUTHOR: Gambaryan, L. S.; Gasparyan, Yu. M.

ORG: none

TITLE: Some bionic aspects of the reliability of sensory information transmission

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 28

TOPIC TAGS: biologic model, nerve fiber, information processing, neuron, human sense

ABSTRACT: A theoretical and probability model of the work of an individual nerve fiber (a single channel of communication) under certain assumptions is proposed. This model permits determination of the probability of transmission of a single neural impulse (the carrier of information) along the fiber. Analysis of the data permits us to assume that: 1) transmission of the neural impulse along the fiber has a probability character, the fiber is not a passive channel for information transmission, and specific processing of information takes place in it; and, 2) a single nerve fiber functions comparatively unreliable. However, in transmitting information along the receptor-fiber system, the system as a whole functions more reliably than its components. This is ensured by specific coding of the external stimulus in the bundle of sequential impulses. Reliability increases in the neural trunk due to duplication of transmission channels. The polyanalyzer principle of organization of functions on the level of an individual nerve cell is expressed in the multisensory convergence of impulses of different modalities on a given neuron. The polyanalyzer principle of organization of functions leads to a considerable increase in the logical reliability of the system.

284.

AUTHOR: Gambaryan, L. S.; Mkrtchyan, S. O.; Gasparyan, Yu. M.

ORG: Neurobionics Laboratory AN ArmSSR, Erevan (Laboratoriya neyrobioniki AN ArmSSR)

TITLE: Cybernetic aspects of some reliability problems of transmission and processing of information in the nervous system

SOURCE: Soveshchaniye po problemam vysshey norvnoy deyatel'nosti, 21st, 1966.  
Tezisy i referaty dokladov. Moscow, Izd-vo "Nauka", 1966, 85

TOPIC TAGS: brain, neuron, biological model, mathematic analysis

ABSTRACT: In the process of evolutionary development of biological systems, the mechanisms and organizational principles contributing most to survival are the ones which were developed and reinforced. Considering that biological systems represent transmission and data processing systems, it appears quite promising to utilize their basic principles of organization and function in the design of highly reliable radioelectronic systems. Considering that nerve fibers act as information transmission channels in the neuron organization of the brain, mathematical analysis data are presented on nerve fiber reliability based on results of recent electrophysiological investigations. A formula for nerve fiber reliability is derived showing that the functional reliability of the biological conductor as a system is very high, even with unreliable functioning of its elements. Neurophysiological data of Soviet and foreign scientists on the polyanalyzer activity of the brain, polysensory convergence of impulses on cortex neurons and subcortex structures, and also the high reliability of work performed by the brain indicate that the polyanalyzer and polysensory principle of functional organization leads to increased reliability of biological system activity. Orig. art. has: none.

285.

AUTHOR: Gasparyan, Yu. M. (Erevan Polytechnical Institute)

ORG: none

TITLE: Reliability of information transmission along a nerve fiber

SOURCE: Mezhvuzovskaya nauchnaya konferentsiya po neyrokibernetike, 2d, Rostov-on-Don, 1965. Problemy neyrokibernetiki (Problems of neurocybernetics); materialy konferentsii, v. 2. Rostov-on-Don, Izd-vo Rostovskogo univ., 1966, 30-35

TOPIC TAGS: nerve fiber, mathematic model, reliability, signal transmission

ABSTRACT: On the basis of electrophysiological data, a formal model of a nerve fiber is presented. It is assumed that a nerve fiber has N Ranvier nodes. The minimal number of contiguous blocked Ranvier nodes which an impulse can no longer skip is designated by  $r$ ; that is, an impulse can skip  $r-1$  nodes. It is also assumed that Ranvier nodes can be found in only two states: ready for excitation (normal) and

blocked. The probability that the Ranvier nodes will be in a normal state is equal to  $P$ ; then probability of a blocked state is equal to  $q$  where  $q = 1 - P$ . An impulse originating at the start of a fiber can spread to the end of the fiber if  $n < r$  where  $n$  is the number of contiguous unexcited Ranvier nodes. And, probability  $P_n(n < r)$  will determine the transmission reliability of a nerve impulse. Determination of the reliability of a nerve fiber is reduced to calculating the probability of the nonappearance of the event at the same time when the contiguous Ranvier nodes are blocked. On the basis of Bernoulli tests, "success" is represented by  $P$  and "failure" is represented by  $q$ , and  $P + q = 1$ . It is necessary to calculate the probability of the nonappearance of the event with  $n \geq r$  where  $n$  is the number of contiguous failures of  $N$ . Probability of transmission of an impulse along a nerve fiber with  $N$  Ranvier nodes and with maximal conductivity of  $r$  can be calculated according to:

$$P_N(n < r) = \begin{cases} 1 \text{ при } N < r \\ 1 - q^r [1 + P(N - r)] \text{ при } r \leq N < 2r \\ 1 - q^r \sum_{i=0}^{N-1} a(i) + \sum_{i=1}^{N-2} b(i) \text{ при } N \geq 2r + 1 \end{cases} \quad (4)$$

$$P_N(n > r) = \begin{cases} 1 \text{ при } N > r \\ 1 - q^r [1 - P(N - r)] \text{ при } r < N < 2r \\ \frac{(1 - q^r(1 - r \cdot P))^{N-r+1}}{(1 - q^r(q + r \cdot P))^{N-r}} \text{ при } N \geq 2r + 1 \end{cases} \quad (5)$$

$$P_N(n > r) = \begin{cases} 1 \text{ при } N < r \\ 1 - q^r [1 + P(N - r)] \text{ при } r < N \leq 2r \\ (1 - q^r) \left(1 - \frac{Pq^r}{1 - q^r}\right)^{N-r} \text{ при } N > 2r + 1 \end{cases} \quad (6)$$

Since in real nerve fibers  $N \geq 2r + 1$ , for further analysis only this part of formulas (4), (5) and (6) is used. For convenience, formula (6) is used with  $N \geq 2r + 1$ ; thus:

$$P_N(n < r) = (1 - q^r) \left(1 - \frac{Pq^r}{1 - q^r}\right)^{N-r} \quad (7)$$

From this formula it is clear that with increase of  $P$  and  $r$ ,  $P_N(n < r)$  grows; and, with increase of  $q$  and  $N$ ,  $P_N(n < r)$  decreases. The simplest calculations according to formula (7) show that with  $N \gg 2r + 1$  the probability of transmission of a single impulse  $P_N(n < r)$  is exceedingly small. This concurs with literature data which show that information is carried by a bundle of successive impulses rather than by single impulses. Orig. art. has: 9 formulas.

286.

AUTHOR: Ivanitskiy, G. R.; Blinkov, A. A.

ORG: none

TITLE: The lateral geniculate body as a system for transformation of visual signals

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 36-37

TOPIC TAGS: cat, visual signal, neuron, cerebral cortex, visual physiology, signal transmission, automatic control system

ABSTRACT: The neuron activity of the lateral geniculate body and the activity of the reticular formation of the brain stem and of the tractus opticus of the cat were investigated, to obtain data on the influence of nonstationary changes in the spontaneous activity of neurons of the lateral geniculate body on conduction of visual information. Some specific effects of cortical and reticular controls on the transmission of signals from the retina and methods of separating weak reactive signals with a background of spontaneous impulsion were examined. A functional diagram for transformation of visual signals in a lateral geniculate body is presented.

287.

AUTHOR: Ivanitskiy, G. R.; Blinkov, S. M.

ORG: none

TITLE: Speed of information processing in human sensorimotor tracts

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 52-53

TOPIC TAGS: man, information processing, sensory motor area, visual perception, audition

ABSTRACT: Equipment was developed to investigate the motor reactions of a man solving a one-dimensional signal tracking problem changing in time according to a specific program. A signal  $f(t)$  is given to any one of the subject's visual or auditory receptors. During investigation of vision a point of light shifting on an oscilloscope screen serves as the signal. During investigation of hearing a sound in a telephone headset changing in intensity is the signal. The signal determines the subject's motor reaction  $\varphi(t)$ . The difference  $\delta(t) = f(t) - \varphi(t)$  is the quantitative measure of tracking error, and the subject strives to reduce this error to zero. Two sensorimotor systems, vision with hand movement and hearing with

final movement, were simultaneously using the same program. The similarity and difference between tracking processes of the right and left hands of healthy subjects were studied. There is a distinct correlation between these tracking processes which does not depend on right or left handedness. Different subjects also have individual tracking features common to the work of both right and left hands. The speed of information processing in the visual and auditory analyzers was compared in healthy subjects and in subjects with focal lesions of the brain. Since the method developed makes it possible to compare the work of both hemispheres of the brain, it is possible to evaluate the work of the brain as a black box with two inputs (vision, hearing) and two outputs (right and left hands). A change in the nature of tracking when there are lesions of different parts of the brain provides an approach for finding a connection between the speed and quality of information processing in human sensorimotor tracts and in the brain structure.

200.

AUTHOR: Kalinich, D. S.; Kuznetsov, S. A.

ORG: none

TITLE: Perception and processing of information in different links of the lateral line analyzer of fish

SOURCE: Vsesoyuznaya konferentsiya po neirokibernetike, 3d, Rostov-on-Don, 1967. Problemy neirokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 58-59

TOPIC TAGS: fish, information processing, bioelectric phenomenon, neuron, sensory motor area

ABSTRACT: Stimulation of single receptors by water currents in a direction toward the tail of the fish leads to sharp increase in the sequence frequency of electric discharges. Stimulation of single neuromasts by water currents in the direction toward the head leads to the complete disappearance of electric discharges. The sequence frequency of spontaneous discharges from single neuromasts also depends on the rate of flow. Thus, increase in the rate of flow of the stimulating stream leads to gradual increase in the sequence frequency of discharges up to a maximum value at a rate of flow from 20-26 mm/sec. Further increase in water flow leads to decrease in the sequence frequency of impulses until they disappear completely. The sequence frequency of electric impulses of single neurons of the acoustico-lateral region of the medulla oblongata and of the cerebellum, on which the lateral line receptors converge, is directly dependent on the electric activity of the receptors during their stimulation. It is supposed that inhibition of electric activity of the nerve with strong water flows induces natural deafferentation of the corresponding sections of the brain which regulate the system of lateral line organs. The activity of those sections declines and the fish slows his movement, which in turn induces intensification of the electric activity of the lateral line organs. This increased electric activity excites the corresponding nerve centers, and as a result the fish again accelerates his movement.

209.

AUTHOR: Kravchenko, V. A.

ORG: none

TITLE: Influence of spatial synchronization of slow activity of the cerebral cortex on the dynamics of excitation transmission

SOURCE: Vsesoyuznaya konferentsiya po neirokibernetike, 3d, Rostov-on-Don, 1967. Problemy neirokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Kostovskogo univ., 1967, 72-73

TOPIC TAGS: animal, EEG, cerebral cortex, biopotential, sensory motor area, visual physiology, probability, excitation energy

ABSTRACT: In continuation of work on a controlled EEG experiment using a Dnepr electronic computer, the experimental procedure was improved by increasing the number of computer input channels and by making certain other changes. This made it possible to study the functional significance of the correlation of biopotentials between the motor zone of the cortex and several points of the visual zone simultaneously, for investigations of spatial synchronization. It was established that the probability of transmission of excitation from the visual zone of the cortex to the motor zone increases linearly with growth of the coefficient of cross-correlation between corresponding biopotentials. The probability of transmission of excitation increases with larger numbers of visual zone points simultaneously synchronized with the motor zone. The cross-correlation coefficient decreases on the average with increase in the distance between the correlated points of the cortex. This decrease indicates the physiological nature of synchronization. It is hypothesized that total spatial synchronization is necessary for transmission of excitation. The probability of transmission of excitation from the visual zone to the motor zone is subject to a certain empirical relationship which depends on the individual characteristics of the animal. Preliminary experimental determination of values entering into this correlation makes it possible to predict the probability of transmission of excitation for a selected value of the correlation coefficient.

AUTHOR: Kuz'minykh, S. S.

CIC: none

TITLE: Lateral inhibition in receptive systems and the capacity of the communication channel

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 80-81

TOPIC TAGS: information processing, visual perception, receiver signal to noise ratio

ABSTRACT: Lateral inhibition was discovered experimentally in the receptive systems of all analyzers and has been most fully investigated in the visual analyzer. A number of authors have demonstrated that lateral inhibition leads to accentuation of nonhomogeneities in the spatial signal. The present investigation covers the effect of lateral inhibition on the capacity of the biological communication channel of receptive systems and higher sections of the analyzers. It was demonstrated that lateral inhibition at the inputs leads to reduction of the average number of impulses in space necessary for input signal restoration with prescribed accuracy. It is supposed that the only noise in the system is quantized noise. The form of the signal does not influence the result, indicating the possibility of reduction in channel capacity. The quantitative gain increases as the spatial spectrum of the signal broadens. The potential possibility for reducing the channel capacity by lateral inhibition at the inputs can not be realized if the channel is stationary. On the contrary, realization is possible with a nonstationary channel (for example, an adapting one) and with simultaneous scanning of the signal by the system of receptors (nystagmus of the eye, a moving image). Thus a possible relationship is established between lateral inhibition (spatial characteristics of the system) and adaptation (time characteristics) of the inputs of the biological analyzers.

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291.

AUTHOR: Lopatin, V. A.

ORG: none

TITLE: Elements of neurocybernetics in the "mother-fetus" system

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 85

TOPIC TAGS: rabbit, embryology, automatic control system, signal transmission, central nervous system

ABSTRACT: The set of two living organisms, the mother and the fetus, can be considered as an unusual dynamic system with internal self-regulation. It is well known that the mother's body is capable of providing stable conditions for the normal vital activity and development of the fetus, sometimes even under strong repeated disturbing influences. The fetus constantly adapts itself to changes in the condition of the maternal body. The hormonal (humoral) connection between mother and fetus provides prolonged and gradual processes of mutual adaptation of the two organisms. More urgent, precise and possible specialized regulation of their interrelations is realized by the nervous system (Garmasheva, Kalinina, Shvarg, and others). This last conclusion is confirmed by present data. It was discovered that thermal and electric stimulation of the skin of rabbit fetuses extracted from the mother but connected with her via the umbilical cord and the placenta, and also the sudden discontinuation of the connection between the maternal organism and the fetus caused by binding the umbilical cord, lead to an activation reaction in the reticular formation of the mesencephalon and the limbic (including hypothalamic) structures of the prosencephalon and in the cortex of the mother. The absence of a direct nerve connection between the maternal body and the fetus has been demonstrated by morphologists. It is most probable that the transmission of information and support of homeostasis in the "mother-fetus" system is accomplished indirectly by change in the closely connected cephalo-placental and uteroplacental blood flows. In so doing the receptor apparatuses are excited and signals enter the central nervous systems of both organisms. The final useful effect of the interaction of mother and fetus is caused to a considerable degree by the reactions of their nervous systems to change in placental blood circulation.

1.92.

AUTHOR: Luk'yanova, O. N.

ORG: none

TITLE: Experimental investigation of information processing in the auditory analyzer during the orientation reflex

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 86

TOPIC TAGS: information processing, audition, reflex activity, cerebral cortex, excited state

ABSTRACT: Processing of afferent information arriving at the central end of the auditory analyzer during performance of the orientation reflex was investigated in experiments on dogs. The orientation was induced with tones of average pitch and intensity, with a click, and with a piercing sound. Changes in the encephalogram and in the induced potentials of the auditory region of the cortex in response to a specific stimulus (in the given case, an audible click) served as indicators for arrival or change in the quality and quantity of afferent information. Facilitation of the conduction of afferent information moving along a specific pathway (decrease in the hidden period, increase in the amplitude and percent of manifestation of the primary response) occurred in response to a new stimulus of moderate strength. The facilitation effect decreased with decrease in the relative strength of the stimulation inducing the orientation reflex. Increase in strength of the new stimulation changed the rise in excitability in a specific auditory pathway into the opposite process of excessive inhibition (increase in the latent period of the primary response, decrease in the amplitude, and reduction of the percent of manifestation). The relationship of the condition of specific pathways to the strength of the new stimulation can be presented in the following form:  $V_1 = V_0 I$ , within the limits of  $I_0 \leq I \leq I_1$ , where  $V_0$  is the standard excitability, and  $V_1$  is the excitability of a specific pathway under the effect of a new stimulation with a specific intensity  $I$ . The function is correct within the limits of a certain threshold value  $I_0$ , sufficient to induce the orientation reflex, and up to a specific value  $I_1$ , the upper limit beyond which distortion in the direction of changes in excitability occurs.

293.

AUTHOR: Lyubinskiy, I. A. (Moscow); Pozin, N. V. (Moscow)

ORG: none

TITLE: Principles of information processing in a model of a neuron network of an auditory system (statics)

SOURCE: Avtomatika i telemekhanika, no. 1, 1968, 160-166

TOPIC TAGS: audition, neuron, biologic model, information processing, acoustic signal

ABSTRACT: A multilayer model of afferent information processing in the auditory system based on a "principle of place" hypothesis is described. The hypothesis states that information on the frequency and intensity of an auditory signal is processed in the neuron layers of the auditory analyzer according to "principle of place," whereby the quantitative characteristics are converted into coordinates of the excited neuron regions. The spatial structure of the model of a neuron network of an auditory system is represented in the form of an inverted pyramid (see Fig. 6) with information on the auditory signal transmitted from the lowest layer of the receptors to the highest layer. In each two dimensional layer information is processed according to two mutually perpendicular axes; x represents the frequency axis and y represents the intensity axis. Changes of the excited areas on the layers with an input of two continuous monotonic signals of different frequencies and intensities are shown (see Fig. 7). As a signal moves to the higher layers, the excited areas become narrower along axis x. Stretching of the excited area and peaking takes place along axis y; stretching increases with increased intensity of an input signal. Both areas on the highest layer (see Fig. 7) converge into points with coordinates x, y, and  $x_2y_2$  determining the frequency and intensity of the signals. The proposed hypothesis assumes the following basic positions: 1) sharpness of the neuron frequency threshold curves in the spiral ganglion is considerably higher than expected due to the high quality of the basilar membrane, and the sharpness continues to increase as it moves to the higher layers; 2) frequency localization of neuron responses which is initially based on the properties of the basilar membrane is preserved at all neuron levels of the auditory system; 3) the range of sound intensities in which the neuron responds is narrowed with movement to higher levels; 4) the number of neurons increases with each level moving upwards; and, 5) the higher the neuron level, the smaller the correlation between neuron response and auditory signal parameters. The authors express their gratitude to G. V. Gorshuni and associates of the Laboratory of Hearing Physiology of the Institute of Physiology im. Pavlov AN SSSR for their great help in systematizing and analyzing the physiological data. The authors also wish to express their appreciation to M. L. Tsetlin (deceased), M. A. Ayzerman, M. M. Rongard, M. B. Berkinblit, N. A. Dubrovskiy and I. A. Shevelev for discussing the work and for their helpful comments. Orig. art. has: 7 figures.

Fig. 6. Spatial structure of a neuron network of an auditory system.

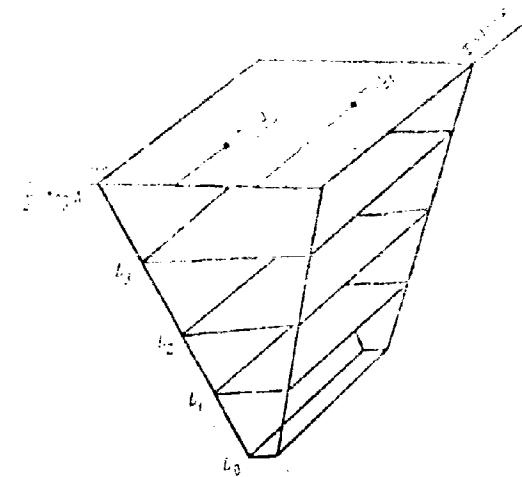
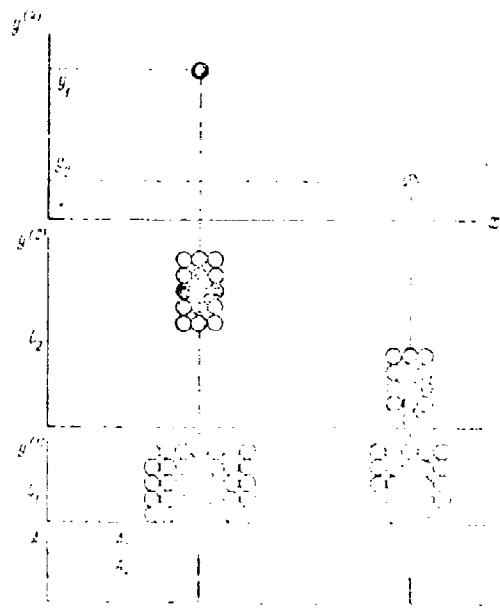


Fig. 7. Configuration of excited areas on different layers of the model.  
A - intensity; x - frequency logarithm.



AUTHOR: Lyubimov, I. A.; Zhdan, N. V.

CODE: none

TITLE: Principle for processing the afferent flow of information in a model of an auditory system neuron network

SOURCE: Vsesoyuznaya konferentsiya po neirokibernetike, 3d, Rostov-on-Don, 1967. Problemy neirokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 87

TOPIC TAGS: signal processing, audition, biologic model, neuron, excited state, bipotential, analog computer

ABSTRACT: Processing by the nervous system of information about acoustic signals is conditionally divided into two stages: transformation of information into a form suitable for future recognition, and recognition itself. The model proposed is a multilayer structure of elements with properties of an analogous neuron, each layer corresponding to the basic levels of switching of fibers in the auditory system. The number of elements in the layers increases in proportion to the transition to higher layers, so that the model can be represented in the form of an inverted pyramid. The layers are homogeneous in structure and the layer elements are completely identical in their characteristics and are linked to each other by direct lateral connections. In the investigation of this neuron network it was assumed that information about both the frequency and intensity of the acoustic signal is transformed according to the "place principle," which is understood as the transformation of quantitative characteristics of an external effect into coordinates of the region of neurons found in an excited state. In the first layer of the multilayer structure examined, an acoustic signal with a pure tone can be considered as producing a sufficiently broad excited region. With transition to higher layers, the place principle is expressed with greater clarity, and finally at a certain level the location of a very small group of excited neurons will single-valuedly characterize the frequency and intensity of the acoustic signal with a pure tone. Analysis of data from electrophysiological investigations demonstrated that the basic regularities for behavior of neurons of the auditory system are explained well by the proposed model. Certain aspects of the work of the model were investigated with an analog computer.

AUTHOR: Malakhova, L. A.; Mel'nikov, Yu. D.

ORG: none

TITLE: Peripheral coding in the lateral line analyzer of fish

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 90

TOPIC TAGS: fish, neuron, information processing

ABSTRACT: Transformation of information in the surface and channel neuromasts and in first order neurons of the organs of the lateral line system of fish is examined. Reactions to stimuli close to the threshold values were studied. Certain general principles for coding information in peripheral sections of the analyzer system are considered.

296.

AUTHOR: Mel'tser, A. D.; Mel'tser, M. I.

ORG: none

TITLE: A mathematic model for human classification of signals as a multichannel system of information processing

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 94

TOPIC TAGS: man, mathematic model, information processing, form recognition, digital computer, learning process, signal identification

ABSTRACT: Investigation of signal perception by man based on the principles of neurodynamics requires the creation of models which can synthesize a single, adequate form of an object from the external environment by analyzing information about qualitative and quantitative characteristics entering by different channels. A mathematic model for form recognition is examined for the case when signals into corresponding channels are interdependent. For this purpose all signals and their selected combinations are depicted in the form of points in a finite n-space of observations, in which subsets, called states of the system, are selected. Matrices

for coefficients of the connection of all points of the space of observations are constructed according to their relation to these subsets. Data from a matrix reflect in a certain sense the learning process as the establishment of corresponding connections between elements of stored information and selection of the most informative subsets. Recognition of signals takes place in accordance with the evaluation which the signals on the selected subsets receive. It is essential that the initial signals be classified without selecting any informative characteristics in them. The proposed mathematic model was realized in a somewhat simplified variation on a digital computer. Investigations demonstrated the advisability of constructing similar models both for study of the processes of form recognition and for construction of technical systems for classifying input signals.

297.

AUTHOR: Navakatikyan, A. O.; Fridland, S. T.

ORG: none

TITLE: Processing of visual information under low intensity stimuli and strengthened afferent stimulation of the central nervous system

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 97-98

TOPIC TAGS: visual perception, central nervous system, light biologic effect, information processing, form recognition, probability

ABSTRACT: The speed of processing visual information under conditions of low illumination (2-10 lux) was investigated by presenting simple and complex visual forms to subjects. The speed of information processing attained a maximum at a specific exposure. Increase of this exposure induced a certain increase in the reliability of recognition but decreased information processing speed. Change in the speed with increase of illumination depends on the background contrast of the object. Increased entropy of the system and of the form leads to increase in recognition time and increases information processing speed, although at a slower rate, up to a specific level. The expressiveness of individual differences in information processing speed depends on the size of the alphabet. It was found that information processing speed increases with strengthening of proprioceptive afferent influences and with prolonged increased stimulation of pulmonary receptors which exert a stimulating influence on the reticular formation. A hypothesis was introduced on possible mechanisms for transformation of the volume of the visual channel.

298.

AUTHOR: Novikov, P. P.; Plotnikov, V. N.

ORG: none

TITLE: Use of algorithms for information processing of living organisms for control of production processes

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 105

TOPIC TAGS: algorithm, information processing, biologic model, bioinstrumentation, automatic control, computer simulation

ABSTRACT: Living systems have considerably more complex algorithms for information processing than technological systems. They can learn in different environments, organize rational search, and select information. Their principles can prove useful for controlling complex production processes when the description of the object is entirely unknown or little studied. Algorithms for information processing of living organisms were found in experiments with man and animals under different environments in creating control systems for production processes. Block diagrams of systems for control of the final state and for optimization of the production process and results of simulation on a digital computer are presented.

299.

AUTHOR: Poltyrev, G. Sh.; Stepushkina, T. A.

ORG: none

TITLE: Some nerve signal transformation performed by a group of neurons of the first thoracic ganglion of the river crayfish

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 119-120

TOPIC TAGS: neuron, biopotential, muscle stimulation, crayfish

ABSTRACT: At the present time the opinion is widely held that change in interpak intervals in time is the basic information carrier in a sequence of nerve impulses. Proceeding from concepts that transformation of neuron impulse sequences is performed by spatial and time summation of postsynaptic potentials, it can be demonstrated that it is not the detailed structure of the nerve signal but certain of its generalized characteristics which are important in information evaluation. At the present time concepts are being developed that an action potential can be generated not only in the axon monticulus but also in remote branches of dendrites. There is data indicating that there are several points in the unipolar neurons of invertebrates

in which action potentials can be generated. Experimental investigations were conducted on the river crayfish to study the transformation of an external signal by a group of motor neurons which participate in performing the claw closing reflex. Electric stimulation of isolated afferent fibers connected with the receptive field of the closing reflex and of fibers coming from a proprioceptive organ was used as the input into the ganglion. Electric activity of motor axons of the claw closing muscle was recorded as the output. Impulses with different distributions of interpeak intervals in time were delivered in succession by means of a specially developed stimulator at the inputs of the system. Spatial interaction was studied by independent stimulation of the two inputs defined above.

300.

AUTHOR: Ponomareva, I. D.

ORG: none

TITLE: Analysis of nerve activity information processes

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 120-121

TOPIC TAGS: neuron, biopotential, digital computer, algorithm, correlation function, information processing

ABSTRACT: Sensory information is defined with a space-time code. Time features of the frequency discharge of a cell reflect not only its internal properties, but also the regularities of information processing by the system of cells. Information processes in the nervous system are studied by recording the impulse activity of individual neurons with microelectrodes. Recording and study of processes occurring simultaneously in different parts of the nervous system are of great interest. The problem of perfecting and finding new algorithms for processing impulse activity, the realization of these algorithms on a digital computer, and the problem of constructing specialized devices are all involved in the development of electrophysiological procedures. Histograms of time intervals define the most adequate frequency operating conditions of the cell. Autocorrelation and cross-correlation functions demonstrate the degree of relationship of frequencies in different time intervals for one and two neurons. As the analog of the cell's "internal memory", the autocorrelation function makes it possible to find certain transmitting characteristics including the transmission band. A proposed method for the processing impulse activity finds, according to the initial system, the conditional probabilities of the system of standardized evaluations in the form of a set of functions. Coefficients were obtained as a result of Bayes' transformations. The completeness of the obtained system of evaluations was proven. An algorithm was developed for finding histograms of time intervals and of analogs of autocorrelation and cross-correlation functions in a discrete form.

301.

AUTHOR: Pushkina, A. G.

ORG: none

TITLE: Information mechanisms of reactions to a relationship and the problem of simulating sensory systems in cybernetics

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 126

TOPIC TAGS: man, brain, information processing, biologic model, visual perception, form recognition

ABSTRACT: Reaction to a relationship between objects (the transposition of relationships) has been investigated from various viewpoints by psychologists and physiologists and is a specific problem of information processing by the brain. In spite of much experimental and theoretical research, transposition phenomena and their information mechanism cannot be considered as definitively explained. Transposition of size relationships was studied in 340 children aged 1-7 yrs. Two geometric figures differing in size were presented simultaneously to a child, while the smaller of them was reinforced. New pairs of geometric figures were introduced in control experiments and cases of correct and erroneous transposition were recorded. It was found that the results of transposition depend not only on age but also on the special organization or orientation activity with objects. Best results were obtained with complex visual and tactile orientation. Motion picture filming of eye movements during perception of size relationships established that a model of the relationship between objects was formed in the child in previous presentations. This model was actualized during presentation of the control experiments. This allows the supposition that the transposition mechanism is related to the recognition mechanism. Results of the investigation make it possible to plan simulation methods of object perception systems as a kind of form recognition.

302.

AUTHOR: Rastrigin, L. A.; Mayerovich, I. M.; Gel'fanbeyn, Ya. A.

ORG: none

TITLE: The human information processing rate as an index of the functional state of the cortical link of the auditory analyzer

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 128

TOPIC TAGS: man, information processing, cerebral cortex, audition, neuropathology, mathematic model

ABSTRACT: The human auditory information processing rate essentially depends on the functional state of the cortical link of the auditory analyzer. This condition is

determined by many factors, of which one of the most important is craniocerebral trauma. It was demonstrated that change in the information processing rate in different stages of posttraumatic states makes it possible to evaluate objectively the degree of injury and the dynamics of recovery of the disturbed analyzer function. The information characteristics obtained in an experiment with special equipment made it possible to construct a mathematic model of a psychomotor reaction to a complex vocal influence using the black box theory. The proposed method can also be used for diagnostic determination of the functional state of different sections of the brain under normal conditions and for determination of the extent of brain injury in pathology.

303.

AUTHOR: Romanov, V. D.

ORG: none

TITLE: Calculation of nerve channel capacity

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 130-131

TOPIC TAGS: nerve fiber, neuron, visual physiology, neurophysiology

ABSTRACT: Information about external effects or internal changes is transmitted to the central nervous system of a living organism by nervous excitation. Axons of intermediate and intercalary neurons serve as the channel of this communication system. Capacity of an axon of the intermediate neuron is obviously determined by the capacity of the entire nerve channel. If nervous excitation signals are represented in the form of impulses with constant amplitude and duration and if change in the intervals between nerve impulses is considered as discrete, then the capacity of the "elementary nerve channel" through time parameters of the nerve impulse can be expressed by using Shannon's basic definition. The effect of background impulsation (noise in the channel) on speed of information transmission is taken into account by calculating the entropy of Poisson distribution for one discrete interval of the impulsation frequency. An expression for the information transmission speed along one fiber of the optic nerve, which coincides with an empiric formula, was obtained by the method described.

304.

AUTHOR: Semenova, B. V.; Ibragimbekova, Sh. S.

ORG: none

TITLE: Analysis of the action of pharmacological agents from the viewpoint of information process theory

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetiki 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 135-136

TOPIC TAGS: dog, information theory, brain, blood pressure, nervous system drug, drug effect, neuropathology, reflex activity

ABSTRACT: A hypertensive state was induced in dogs based on neurotic processes connected with formation of inadequate programs for work by the brain in the control of blood pressure, in which programs of the highest level played the decisive role. Administration of reserpine alone did not lead to disappearance of the pathological work programs or to any change in the work of programs of the highest levels. Extinction of the work of programs of the highest levels did not lead to a positive effect in the absence of reserpine. Extinction proved possible after administration of reserpine. The experimental data demonstrate the complexity of the information processes on which the pharmacological agents act. Reserpine does not act on the part of the programs which directly provides pathological systems of reflexes, but does act on a higher level program which corrects and changes the development of programs of the highest level.

305.

AUTHOR: Semenova, T. P.

ORG: none

TITLE: The hippocampus and information processing in complex forms of behavior

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 135

TOPIC TAGS: rat, conditioned reflex, learning process, information processing, probability, brain, injury, behavior pattern

ABSTRACT: Chain conditioned reflexes were developed in rats and individual sections of the hippocampus were subjected to electrolytic destruction before and after learning. Injury to the hippocampus deprives the animals of the capacity to optimize the learning process. The probability of the developed conditioned reflex remained low during the entire learning period and fluctuated from 0.3-0.37, while in the control group it rose to 0.6. Injury to the hippocampus also leads to sharp change in rat behavior tactics under a complex multidimensional environment, in particular to an increase in specific orientation activity in various stages of learning.

306.

MATHEMATICAL MODEL OF INFORMATION PROCESSING IN THE HUMAN VISUAL ORGAN

ORG: none

Shabanov-Kushnarenko, Yu. P. AN UkrSSR. Modelirovaniye v biologii i meditsine (Modeling in biology and medicine), no. 2, Kiev. Naukova dumka, 1966, 100-106. AT7009690

The present study considers only the information-processing aspect of vision, mainly, the problem of how visual information is converted into visual perception. Light rays emitted from the surface of visible objects represent the visual information input and visual preception represents the output. Any visual picture in a given visual field can be described as:

$$E = E(x, y, t)$$

where  $E$  is the input signal,  $x$  and  $y$  are field coordinates, and  $t$  is time. Visual perception can be described by:

$$B = B(x, y, t)$$

where  $B$  represents the output signal,  $x$  and  $y$  are field coordinates, and  $t$  is time. The problem of modeling visual processes consists of finding and describing mathematically the law by which  $E$  is converted into  $B$ . On the basis of psychophysical data, a mathematical model of the visual organ is presented (see Fig. 1).  $E(x, y, t)$  represents the input signal and

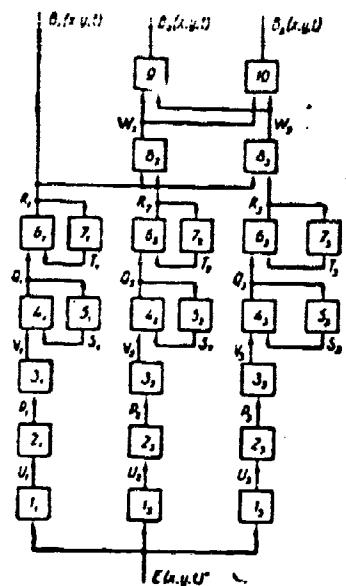


Fig. 1.

$B(x, y, t)$  represents the output signal whose components are brightness  $B_1(x, y, t)$ , saturation value  $B_2(x, y, t)$ , and color shade  $B_3(x, y, t)$ . The model consists of different units, each of which is described by an equation connecting input with output signals. Using the proposed mathematical model, various visual functions can be described, including visual accommodation. UDC: none [06]

AUTHOR: Shabonov, A. I.

ORG: none

TITLE: Change in information connections in the human spinal cord under prolonged effect of uniform signals

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 165-166

TOPIC TAGS: spinal cord, muscle stimulation, spinal nerve, nerve, bioelectric phenomenon, man

ABSTRACT: Signals entering communication channels from external stimulation were compared with signals reaching the destinations to study the capacity of the channels, using the ulnar nerve, whose stimulation induces a synchronous volley of impulses, and a flexor muscle of the wrist. The electromyographic response of this muscle gives some indication of the quantity of signals sent and the quantity of signals passing through the spinal cord. Calculation of the probability of signal transmission in six subjects under conditions of strict uniformity of movements performed by the flexor muscle of the wrist indicated that the prolonged effect of a flow of sensory and effector signals converging on the motor neurons blocks their capacity. It was concluded that the effect of signals carrying a relatively small quantity of information rapidly leads to blocking of the effector mechanisms of the segmental apparatus of the spinal cord.

308.

AUTHOR: Shminke, G. A.; Lebedeva, L. I.

ORG: none

TITLE: Application of the feedback principle to self stimulation of uterine contracting activity during human chilbirth

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 166-167

TOPIC TAGS: feedback, muscle stimulation, gynecology

ABSTRACT: Information about uterine contracting activity was read with a tensometer from the area of the fundus uteri and was transmitted to an automatic electronic potentiometer. With the appearance of uterine tonic tension a regulating system was automatically switched on, feeding a galvanic current to the spinal cord. The system acted as an electric bridge. In this case feedback is positive, the size of the stimulus growing in proportion to increase in uterine tonus. Examination of 42 parturients demonstrated that the feedback leads to significant intensification of uterine activity.

309.

"ELECTRICAL LANGUAGE" OF THE NERVOUS SYSTEM

ORG: none

Sovjetunion heute, no. 8, 1967, 15.

AP7014185

Leningrad researchers have discovered that the human heart, muscles, and nerves emit an electrical field. The first "electroauograms," records of the electrical field of nerves, were recently shown at a meeting of the Natural Science Society. The recording process was developed in the Laboratory for Physiological Cybernetics of Leningrad University. The electroauogram of a human heart was successfully recorded at a distance of 10 cm. These experiments have demonstrated that the human body is surrounded by an electrical field that can be instrumental, i.e., recorded, and measured. [DM]

310.

AUTHOR: Val'tsev, V. B.

ORG: none

TITLE: A mechanism for coding prolonged intervals of time in a peripheral section of the visual analyzer

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 18-19

TOPIC TAGS: visual activity, time, visual simulation, nervous system, data correlation

ABSTRACT: The capacity of peripheral sections of the visual analyzer to reflect adequately the time characteristics of stimuli presented for a prolonged time was investigated. The dependence of separate processes in the retina of the frog on the time characteristics of single and rhythmic stimuli with different combinations applied jointly and separately was analyzed and compared. It was established that with a stable intensity of stimuli their time parameters are most adequately reflected in responses to switching off a light stimulus. The conclusion was drawn that this reaction provides sufficiently exact information about relatively simple time

indicators. It reflects the time from start to end of a stimulus, the time sequence of stimuli presented in darkness and on a background of constant light, and the action time of a stimulus preceding the test stimulus. Correlations of switching-off responses and of time parameters for stimuli prolonged in time were traced, and their quantitative characteristics are presented. These correlations are based on a clearly expressed capacity for summation, that is, accumulation of neural processes during the period of light action. This capacity appears with the gradual growth of the aftereffect reaction as the time of any stimuli combination is increased. Information is given about certain mechanisms for generation of switching-off responses. These mechanisms characterize this process. The aftereffect reaction of a light stimulus may appear to be an unusual way of marking the time of presentation and duration of stimulus action. However, this reaction is one of the mechanisms forming and sustaining the capacity of the nervous system to evaluate time characteristics of stimuli presented for a prolonged time.

### 311.

AUTHOR: Vasilevskiy, N. N.

CRG: none

TITLE: Statistical characteristics of the transmitting functions of neurons

SOURCE: Vsesoyuznaya konferentsiya po neirokibernetike, 3d, Rostov-on-Don, 1967. Problemy neirokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 19-20

TOPIC TAGS: neuron, cerebral cortex, biologic model, statistic analysis, data transmission

ABSTRACT: The permeability characteristic of individual neurons is the most important part of the problem of studying mechanisms for processing and transmitting information in neural structures. Determination of this characteristic must be based on precise knowledge of the modality of sensory influences and of the organization of the receptor area of the cell. The permeability of projective neurons of the somatosensory region of the cortex of the large hemispheres, with local receptive fields reacting to rhythmic tactile stimulation of cutaneous receptors, was studied in detail. The "expected frequency" function was chosen for statistical analysis of permeability (Poshio and Virnhaeys, 1964). This statistical method determines precisely which frequencies of tactile stimulations are reproduced by the cells and what average level of impulse activity corresponds to the reproduced rhythm of stimulation. Furthermore, this method allows characterizing in detail the intermediate activity and growth rate of adaptive phenomena. It was discovered that rapidly adapting neurons (type I) of the cortical projective zone of the cutaneous analyzer have different spectral characteristics of perceptually reproduced stimulation rhythms from 10-100 cps. A neural model of differential sensitivity to different frequencies of a specific stimulus is examined. It is assumed that the entire network of neurons reacts at low frequencies of stimulation. Individual-neuron groups are selectively switched off according to the special features of their frequency characteristic as the frequency of stimulation increases. The question of the functional structure of the neural networks of the sensory systems is considered.

312.

AUTHOR: Yasinovskaya, F. P.

ORG: none

TITLE: Information principles from the heart mechanoreceptor system

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 169

TOPIC TAGS: heart, nerve, biopotential

ABSTRACT: Auricular mechanoreceptors react to all kinds of mechanical deformation accompanying the cardiac cycle, such as auricular strain in the systole, tension of the auricular wall in the initial stage of ventricular systole, and diastolic filling of the auricles. The quantitative characteristics of volleys (appearance time, number and frequency of impulses in the volley, and duration) reflect the strength, rate, and duration of the auricular systole and diastole and of the ventricular systole. Data confirm that all types of volleys of the auricular mechanoreceptors occur from the effect of a single adequate stimulus--stretching on the receptor endings. The generality of the stimulus determines that the volley is not highly reinforced for a given receptor. The feasibility of using a single receptor apparatus for information about different mechanisms in a myocardial microsection was demonstrated. Information about the heart mechanism as a whole is produced by the entire system of mechanoreceptors of the heart and adjacent vessels. This system is formed from the mechanoreceptor concentration zones. The arrangement of receptor zones into an input and output with distinctive characteristics of volley activity suggests that integral evaluation of the heart's work is possible.

313.

AUTHOR: Yenel'yanov, I. P.

ORG: none

TITLE: Some parameters of brain electric activity connected with information processing in the visual analyzer

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 41

TOPIC TAGS: information processing, visual perception, EEG, brain, neuron, parameter, bicelectric phenomenon

ABSTRACT: Certain authors (Peymer, Genkin, Yenel'yanov) have hypothesized that change in the difference of durations of fronts (CDDF) of an EEG can reflect the dynamics of integral excitability of the cortical neurons. To clarify the role of CDDF in processing sensory information in the brain, the reaction of the CDDF of a human EEG to a light stimulus (prolonged rhythmic photostimulation) was studied. Type I and II waves were previously discovered to exist in the period of stimulation action on the CDDF curves (Yenel'yanov). It is assumed that type I and II waves have different functional origins and different mechanisms. These mechanisms play an active part in processing sensory information and their activity is characterized by individual features in respect to each stimulus presented and depends on the initial functional state of the central nervous system. The problem of CDDF processes participating in the mechanisms of short term memory is considered.

SECTION E. STUDIES IN ANIMAL ORIENTATION, NAVIGATION, LOCATION,  
AND COMMUNICATION

314.

AUTHOR: Ayrapet'yants, E. Sh.; Konstantinov, A. I.

ORG: none

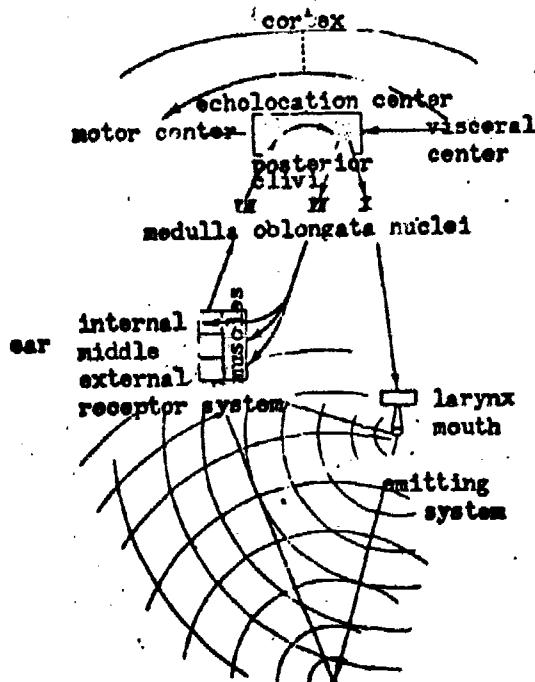
TITLE: Investigation of the echolocation nervous mechanisms of bats

SOURCE: AN SSSR. Nauchnyy sovet po kompleksnoy probleme "Kibernetika". Voprosy bioniki (Problems of bionics) Moscow, Izd-vo "Nauka", 1967, 445-453

TOPIC TAGS: bat, neurophysiology, echolocation, cerebral cortex, audition, ultrasonic wave

ABSTRACT: The study presents a literature survey of the newest echolocation data on bats including ultrasonic signal parameters, characteristics of the emitting system, characteristics of the receptor system, and the central apparatus of echolocation. The work of the nervous mechanisms and structures regulating the activity of the echolocation system is described (see Fig. 4). The role of cortex apparatuses in higher integration of echolocation system spatial analysis is not clear at this time. The participation of the cortex apparatuses is certain, but the exact nature of their role requires further investigation. The subcortex apparatus of the echolocation system is located in the posterior clivi where the visceral signals (hunger) are first to arrive. These signals evoke the synchronous readiness of the motor hearing and larynx apparatuses. The search for food starts with flight and the emission and perception of ultrasonic impulses. Simultaneously with the ultrasonic probing the receptor system becomes ready to protect the cochlea from excessively high stimuli and becomes tuned to specific frequencies. The reflected information is first processed in the receptor system and then passes through the medulla oblongata nuclei into the posterior clivi. Analysis takes place at this level and further discrete regulation of the elements of the complex spatial orientation apparatus, and also formation of behavior acts. Orig. art. has: 4 figures.

Fig. 4. Diagram of echolocation nervous mechanisms of bats.



315.

AUTHOR: Blagosklonov, K. N.; Rodinov, V. A.

ORG: none

TITLE: Individual orientation capability of *Muscicapa hypoleuca* during nesting time

SOURCE: AN SSSR. Nauchnyy sovet po kompleksnoy probleme "Kibernetika". Voprosy bioniki (Problems of bionics) Moscow, Izd-vo "Nauka", 1967, 514-518.

TOPIC TAGS: bird, behavior pattern, reflex activity

ABSTRACT: Homing time was studied in groups of up to 178 birds of the *Muscicapa hypoleuca* genus brought in boxes swiftly rotated in alternately opposite directions to points of release at 500 m SE from the nest during the nesting period and then repeatedly released from other points in other directions but at the same distance from the nest. The highly diverse behavioral patterns of experimental birds are summarized as (1) the prevailing tendency to fly directly toward the nest or first in a NE direction (up to 40% of birds), and (2) the average arrival time of 55 min, with a minimum time of 24 min, a maximum

time of more than 2 hrs, and a mean speed of 0.3 km/hr. The homing time of the repeatedly released individual birds increased, however, as a result of training, regardless of the direction of the point of release. It is believed that these observations indicate a reduction in the navigation capability of nesting birds and also suggest that this property is essentially not different from other complex chain reflexes, in being cyclic and having strongly pronounced maxima during migrations twice in the year. Orig. art. has: 2 tables.

316.

AUTHOR: Bodryagin, V. I.; Levchenko, I. A.; Frantsevich, L. I.; Shalimov, I. I.

ORG: none

TITLE: Means of transmitting information by the honeybee on the spatial position of a food source

SOURCE: AN SSSR. Nauchnyy sovet po kompleksnoy probleme "Kibernetika". Voprosy bioniki (Problems of bionics) Moscow, Izd-vo "Nauka", 1967, 497-500

TOPIC TAGS: bee, communication signal, bionics

ABSTRACT: Signal dances of gray Ukrainian bees returning from feeders filled with sugar syrup at distances up to 3 km from the hive were studied. Movements of the bee were recorded with an accelerated movie camera, and sounds produced by the bee were recorded with a magnetic recorder supplied with a microphone and preamplifier. The phonograms were interpreted with the help of a cathode oscillograph and a loop oscillograph. Frequency characteristics of the sounds were studied on a sound frequency spectrograph. The bee performs a dance on the honeycomb in the form of a circle alternating between clockwise and counter clockwise directions. At a certain segment of the circle the bee rapidly sways from side to side with a frequency of 12-14 cps (see Fig. 1). The dance cycles repeat dozens of times with the number of swayings directly proportional to the flight distance to the food source. The direction of the dance in relation to the vertical axis (on vertical honeycombs) or external light source (on horizontal honeycombs) is equal to the angle between the flight route and direction of the sun; and, with movement of the sun, the direction of the dance changes. At the beginning of each half cycle of the swayings, the bee makes 3-4 flaps with its wings which are folded on its back. As a result, short sound messages appear with a mean succession rate of 27.6 cps, a carrier frequency of

284 cps coinciding with the frequency of wing flaps and duration of message 16.4 msec. The number of sound messages and the duration of sound during the swaying is directly proportional to the distance of the food source. Since both processes, swaying and wing flapping, take place at rates which are almost maximal for the corresponding muscle groups, there is no precise synchronization between the swayings and sound messages and they are combined at random. Thus, it is inadvisable to evaluate the volume of information transmitted in the dance by the different characteristics of the sound accompanying the dance. Generation of sound accompanying the dance probably allows the bees to keep track of the dancing bee even with loss of direct contact. The dance of the bee as a means of transmitting information represents a unique phenomenon in the animal world, and possibly is the result of evolution over a long period of time. Actually, separate elements of the dance can be found in lower forms of bees and insects. The movements of the honeybee could be simply the result of an excited state and do not necessarily represent useful signals for other bees. Thus, it is of utmost importance to study the behavior of the bees present at the time of a dance and to determine to what extent the bees perceive and utilize the information contained in the dance. Orig. art. has: 4 figures.

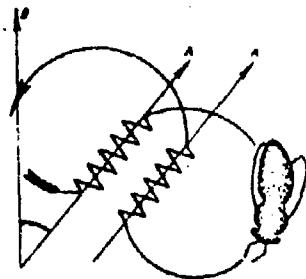


Fig. 1. Diagram of bee movements during two cycles of the dance.

A - direction of food source;  
O - direction of sun.

317.

AUTHOR: Dol'nik, V. R.; Shumakov, M. Ye.

ORG: none

TITLE: Navigation capability testing of birds

SOURCE: AN SSSR. Nauchnyy sovet po kompleksnoy probleme "Kibernetika". Voprosy bioniki (Problems of bionics) Moscow, Izd-vo "Nauka", 1967, 500-507

TOPIC TAGS: bird, animal experiment, navigation, bionics

ABSTRACT: In studying the navigation capabilities of birds, the authors combined two common investigating methods of releasing birds at a distant unfamiliar location and studying birds in a planetarium. Four species of birds were investigated: *Carpodacus erythrina*, *Sylvia nisoria*, *Fringilla coelebs* and *Sturnus vulgaris*. The first two species are distant migrants flying in the fall to southeast Asia and eastern equatorial Africa respectively. The other two species migrate to England and southwestern Europe respectively. All four species belong to the bird population of the Kursk sandbar on the Baltic Sea. After the birds were caught, they were placed into circular cages under an open sky. The cages are a modification of the Cramer cage; the diameter is 85 cm and the sides are 25 cm high made of a nontransparent plastic which serves as a screen. In the center of the cage is a round ring, the starting point, and it is surrounded by eight perches placed to correspond to the countries of the world. The perches are connected to an electric circuit so that each time a bird alights on a perch, contact is made and a counter away from the cage records the number of times a bird alights on each of the perches. When the birds displayed signs of readiness for migration (fatty deposits and migratory agitation), the direction of migratory agitation was recorded for each bird. Then the birds were flown by plane from the Kursk sandbar to the following points: *Carpodacus erythrina* and *Sylvia nisoria* to Dushanbe (7-13 September) and Khabarovsk (15-22 September); *Fringilla coelebs* and *Sturnus vulgaris* to Murmansk (29 September-7 October) and Sevastopol (10-17 October) and *Fringilla coelebs* also to Dushanbe (8-13 November). Upon arrival the birds again were put into circular cages which were placed on elevated sites so that they could only see the sky. Conditions were favorable for these experiments during the fall of 1964 since at all points the weather was clear and the birds could see the sun and the stars. Activity of birds in the cage was recorded round the clock and readings of counters were taken every 3-4 hours. The degree to which the basic direction ( $k$ ) is expressed is described as the ratio between the sum of activity of all directions and the most expressed direction;  $k$  changes from 1 (absolutely correct direction) to 8 (complete absence of direction). Findings show that for *Carpodacus erythrina*  $k$  was 1.74 at the Kursk sandbar, 2.85 at Dushanbe and 3.4 at Khabarovsk. For *Sylvia nisoria*  $k$  was 1.89 at the Kursk sandbar, 3.79 at Dushanbe and 3.12 at Khabarovsk. For *Fringilla coelebs*  $k$  was 1.05 at the Kursk sandbar, 1.17 at Murmansk and at Sevastopol the migration direction of  $k$

changed from southwest to south-east. The *Sturnus vulgaris* did not display any clear orientation capability at any of the points. The distinct navigation capabilities of the *Carpodacus erythrina* and *Sylvia nisoria* show they are able of detecting considerable shifts in longitude and possibly in latitude and to make the necessary adjustments in their migration routes. But, the *Fringilla coelebs* and *Sturnus vulgaris*, either the young or the old birds, are not capable of making adjustments in relation to longitude or latitude shifts. In the interest of bionics, experiments should be carried out to determine the minimal shifts that *Carpodacus erythrina* and *Sylvia nisoria* are capable of detecting. Orig. art. has: 5 figures.

318.

AUTHOR: Dyborskiy, V. V. (Engineer)

ORG: none

TITLE: Automatic acoustic apparatus of *Musca vomitoria* for preserving equilibrium in flight

SOURCE: AN SSSR. Nauchnyy sovet po kompleksnoy probleme "Kibernetika". Voprosy bioniki (Problems of bionics) Moscow, Izd-vo "Nauka", 1967, 566-570

TOPIC TAGS: insect, flight physiology, orientation, acoustic tracking, central nervous system, automatic flight control

ABSTRACT: It is suggested that the second pair of the modified rigid wings of the *Musca vomitoria*, having the form of rod-shaped projections positioned laterally on the back of the thorax at a 60° angle to the longitudinal axis of the fly, acts as a flight-stabilizing gyro system. These buzzing projections tend to maintain their orientation in flight by oscillating within a 60° angle to their plane of rest, and have sensors in their base which send signals to the central nervous system when a deviation from the direction of flight occurs. The tips of these projections contain a second group of sensors positioned in the acoustic focus of fixed concave squamae bulging on the thorax next to the projections. It is believed that these squamae function as receptors, resonators and transmitters of the composite noise produced by these flies in an incident air flow during flight. This noise has a spectrum dependent on the performance of the wings and the aerodynamic conditions of flight. Noise received by these acoustic sensors is transmitted into the central nervous system for flight control. An editor's footnote indicates the tentative nature of the author's conclusions. Orig. art. has: 9 figures.

319.

AUTHOR: El'darov, A. L.

ORG: none

TITLE: Experimental study of the characteristic features of behavior in birds during short distance orientation

SOURCE: AN SSSR. Nauchnyy sovet po kompleksnoy probleme "Kibernetika". Voprosy bioniki (Problems of bionics) Moscow, Izd-vo "Nauka", 1967, 524-528

TOPIC TAGS: bird, behavior pattern, conditioned reflex

ABSTRACT: A total of 12 identical slide-cover food boxes, only one of which contained food, were positioned equidistantly at the walls of circular cages, 50 cm high and 70 cm in diameter, in a study of the role of conditioned reflexes in close range orientation of *Sturnus vulgaris* birds, conducted in August-November 1965. An electromagnetic system recorded on tape the order and duration of birds' stay on food box perches while opening the box in search for food. Black square marks (1), mirror square marks (2), and luminous square marks (3) positioned right above the boxes, or light beams directed at the adjacent box (4) or at a box at a 45° angular distance from the food-containing box (5) were used as stimulants in five series of orientation-guidance experiments with a total of 549 tests. In all initial tests, the birds set out with a box-by-box circular or segmentary search but in the subsequent sessions, with the position of the right box changed, they gradually developed a response to a stimulant, so that after 2 (mark 3) to 42 tests (mark 5) they could chose the correct box right away. Orig. art. has: 3 figures and 1 table.

320.

AUTHOR: Il'ichev, V. D.

ORG: none

TITLE: Acoustic location capability of birds

SOURCE: AN SSSR. Nauchnyy sovet po kompleksnoy probleme "Kibernetika". Voprosy bioniki (Problems of bionics) Moscow, Izd-vo "Nauka", 1967, 454-465

TOPIC TAGS: bird, audition, acoustic signal, cerebrum, signal processing

ABSTRACT: The article presents an extensive literature survey on the spatial analysis mechanisms of sound in birds. A structural diagram of the different links of the auditory analyzer of birds is given (see Fig. 7) based on literature data. The central link is the comparator (2) located in the medulla oblongata and connected mostly with the laminary and olivary nuclei. This arrangement ensures the comparison of incoming binaural information and its processing; and, it also actuates the mechanism of direction movements of the head and the parotid sound organizing structures (3, 4) further optimizing the spatial analysis of sound. At the same time the medullar links of the analyzer send information into the higher sections, particularly into the hemispheres(1) for evaluating the biological significance of the sound. The hemispheres through efferent pathways make additional adjustments of the peripheral sections of the analyzer in cases when the sound proves to be biologically significant and the animal needs to find the location of the source. A complex system of processing the signal, transforming it through sound organizing and sound transmitting signals (5, 6, 7), ensures the necessary degree of binaural discrimination and optimizes spatial analysis. Bioacoustic and electrophysiological data show that the role of the peripheral sections of the analyzer is not limited only to passive formation of a certain directivity of the spatial curves thereby forming fields of hearing, but includes active optimization of binaural discrimination. The pterylosis, parotid skin folds and meatus also play an important part in these processes. Of special interest is the asymmetrical development of sound organizing systems of the external ear as observed in owls. The degree of asymmetry in the structure of the right and left ears sharply increases in groups with well developed capability for locating sound. Asymmetry is best expressed in the night owls, Tyto, Strix and Asio in which the size ratio between the right and left external concha is 1:4 or more; but, in daytime species of owls asymmetry of the external ears is absent. Asymmetry in owls can be considered a form of adaptation related to improving spatial hearing; however, its exact role is not clear at this time. Orig. art. has: 7 figures.

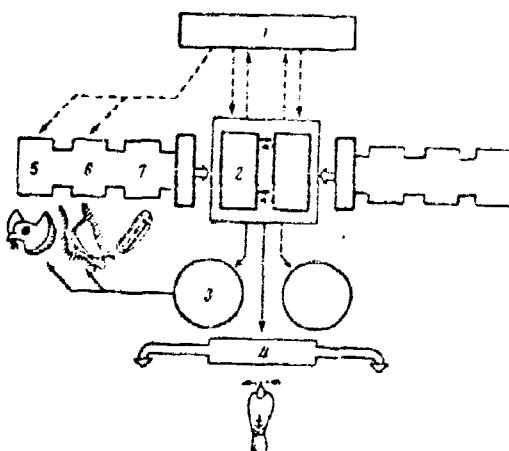


Fig. 7. Structural diagram of the participation of different links of the auditory analyzer of birds in spatial analysis of sound.

1---cerebral hemisphere sections;  
 2---comparator;  
 3, 4---parotid structures;  
 5, 6, 7---sound organizing and sound transmitting structures.

321.

AUTHOR: Kistyakovskiy, A. B.; Smogorzhevskiy, L. A.

ORG: none

TITLE: Initial distant orientation of some birds of the Passeriformes order

SOURCE: AN SSSR. Nauchnyy sovet po kompleksnoy probleme "Kibernetika". Voprosy bioniki (Problems of bionics) Moscow, Izd-vo "Nauka", 1967, 507-510

TOPIC TAGS: bird, information processing, orientation, bionics

ABSTRACT: In 1963-65 the authors investigated the homing orientation of birds following their release in an unfamiliar location. Experiments were staged on rustic swallows (312), sand martins (141), house martins (99), great tits (406), starlings (66), house sparrows (171) and other birds. In the experiments 1242 birds participated in 1700 releases at distances of 2-100 km from home. After a group of birds was released, they were closely observed to determine the direction of initial orientation searches and speeds of flying. Study data show that the investigated birds very rarely determine the correct homing direction immediately after release. In most cases the birds select a direction close to the spring or fall migration route of the local populations, and only later correct their error. Initial orientation of birds is based on the position of the sun combined with the bird's biological clock and

takes only a minute to decide. An incorrect orientation at the start does not interfere with finding the correct direction later in relation to "home." In the process of solving the problem some birds return to the site of release 10-15 min later and then take off in the correct direction. In the second orientation process some birds use reference points of the postnesting flights of the previous year or of the prenesting search flights of spring. However, the findings indicate that previous contact with a given location does not reduce the time of a return flight. The flight time also is not reduced in cases when birds are released at nearby locations. Thus, study and literature data concur that correct determination of an azimuth in relation to "home" is accomplished without orientation based on reference points stored in the memory. A very close interdependence is found between distant orientation during migration and initial distant orientation during homing. External environment factors perceived by birds and the information processing mechanism involved in determining a specific location represent one of the most difficult problems in the study of bird orientation. Orig. art. has: 2 figures.

322.

AUTHOR: Kleynenberg, S. Ye.; Kokshayev, N. V.

ORG: none

TITLE: Current problems of biological aero- and hydrodynamics

SOURCE: AN SSSR. Nauchnyy sovet po kompleksnoy probleme "Kibernetika". Voprosy bioniki (Problems of bionics) Moscow, Izd-vo "Nauka", 1967, 531-539

TOPIC TAGS: bionics, aerodynamic force, hydrodynamics

ABSTRACT: The current state of bionics is reviewed and future trends are outlined, noting that even though effective economic engineering solutions abound in nature, it would be erroneous to copy nature indiscriminantly, since, due to the strong temperature limitations of a living organism, man made plants are largely superior in terms of power output. It is indicated, on the other hand, that in striving to overcome these limitations by reducing aerodynamic and hydrodynamic drag, nature has developed highly effective low-drag dynamic systems, such as birds, flying insects, fish, and aquatic mammals, which have not yet been understood and fully explained. It is pointed out further that

conventional aerodynamics is not applicable to the low Reynolds number flapping flight of animals (beetles) and that the unknown direction of the aerodynamic force is a specific difficulty encountered in the study of flapping wing lifting bodies propelled by the finite amplitude oscillations of their carrying surfaces. Also discussed is the motion of the porpoise, as a unique example of absolute economic superiority over all man-produced motions, known as the Gray paradox. The purpose of bionics is seen in uncovering the physical nature of devices used by nature to achieve high but least power-consuming locomotive effects, and in expressing the results in a precise mathematical and physical language. Orig. art. has: 1 table.

323.

AUTHOR: Kokshayskiy, N. V.

ORG: none

TITLE: Reynolds number range of biological objects

SOURCE: AN SSSR. Nauchnyy sovet po kompleksnoy probleme "Kibernetika". Voprosy bioniki (Problems of bionics) Moscow, Izd-vo "Nauka", 1967, 543-549

TOPIC TAGS: Reynolds number, biology, aerodynamic force, hydrodynamics, laminar boundary layer, bionics

ABSTRACT: The Reynolds number is discussed as a similarity criterion more suitable for studying the locomotion of swimming and flying animals than the Strouhal number generally used as a similarity criterion for unsteady periodic motions. Noted in support of the use of R numbers on biological objects is a theory that aquatic animals modify their propulsion pattern with varying R numbers. Reynolds numbers, ranging from  $1.7 \times 10^{-3}$  for a protzoa species to  $2.6 \times 10^8$  for *Balaenoptera musculus*, are listed for a group of protozoa, insects, birds, fish and aquatic mammals, including *Stylonichia*, *Paramaecium*

caudatum, Bursaria truncatella, a Ceratopogonidae species, the desert locust, *Troglodytes troglodytes*, *Fringilla coelebs*, *Sturnus vulgaris*, *Colocas monedula*, the gray heron, the gray crane, *Spinachia spinachia*, *Neogobius melanostomus*, *Lucioperca lucioperca*, the shark, *Sphraena barracuda*, the porpoise, *Globicephala melana*, *Orcinus orca*, *Physeter catodon*, and *Megaptera nodosa*. The widely practiced extension of the boundary value problem of a thin plane plate to three-dimensional living bodies is dismissed as basically incorrect. Also disputed is a recent theory of Purves according to which dermal fins of a porpoise produce an acute flow incidence angle almost over the entire animal's body and thus account for the formation of a laminar boundary layer in the incident flow. It is contended, however, that various complex and still undetermined devices must be active in biological objects to adjust their motion to aero- and hydrodynamic conditions at different R numbers. Orig. art. has: 1 table and 3 figures.

324.

AUTHOR: Malyukova, G. A.

ORG: none

TITLE: Chemoreception and group behavior of fish

SOURCE: AN SSSR. Nauchnyy sovet po kompleksnoy probleme "Kibernetika". Voprosy bioniki (Problems of bionics) Moscow, Izd-vo "Nauka", 1967, 465-468

TOPIC TAGS: fish, neurophysiology, oxygen consumption, olfaction, gustation, vision, behavior pattern

ABSTRACT: Intensity of feeding, oxygen consumption, motor activity, rate of growth and sensitivity to toxic substances differ for fish in a group and isolated fish. Reduction of both oxygen consumption intensity and motor activity is considered a "group effect" and is one of the most objective expressions of group behavior. In earlier experiments on minnows, crucian carp and carp it was found that all these fish display the "group effect"; 48% in minnows, 36.3% in crucian carp, and 38.4% in carp. The first problem was to determine whether a fish uses only chemoreception to detect a group of fish. Experiments were staged on single fish in a respirator filled with water which had contained a group of fish for a period of time. Oxygen consumption intensity was measured to determine whether the fish could perceive the

"smell" of the group. All three species of fish clearly reacted to the "smell" of its own species group, but oxygen consumption intensity was not reduced, as could be expected, but was increased considerably. Motor activity also increased. Thus, all experimental fish perceived the "smell" by chemoreception, but group behavior was not induced. In experiments with inactivation of vision, it was found that oxygen consumption intensity is reduced more slowly in fish without sight than in intact fish. Other experiments showed that olfactory and gustatory reception play a role in perceiving the chemical effect of a group of fish. It was also found that fish react to the "smell" of closely related species, but are indifferent to more distant classification of fish. The protective effect of chemoreception was observed in reactions of fish to the "smell" of predator fish and to skin extracts of predator fish, and also to skin extracts of one's own species. Considerable differences of reaction intensities in different species suggest different ecological and physiological significance of chemoreception and chemical signalization in group behavior of these fish.

325.

AUTHOR: Matyushkin, D. P.; Stosman, I. M.

ORG: none

TITLE: Characteristics of neuron networks of the auditory analyzer participating in determination of the direction of an arriving signal

SOURCE: Vsesoyuznaya konferentsiya po neirokibernetike, 3d, Rostov-on-Don, 1957. Problemy neirokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 92-93

TOPIC TAGS: bat, neuron, audition

ABSTRACT: The properties of the auditory system of bats were investigated to study their echolocating capabilities. This system has exceptionally developed subcortical centers and is a convenient object for analysis of certain general principles of the activity of the auditory analyzer of mammals. The microelectrode method was used to analyze the excitability and the nature of the reactions of the posterior clival neurons of the auditory system of bats upon delivery of short sonic and ultrasonic signals at different angles relative to the head of the bat. Among the neurons examined, some are not very sensitive to changes in the angle of approach of the signal, while others are highly sensitive to these changes and are tuned to signals approaching at specific angles. A structure of neuron networks of the auditory centers is discussed in which certain posterior clival neurons are sensitive to signals from specific directions but are relatively insensitive to signals from other directions.

320.

AUTHOR: Naumov, N. P.; Simkin, G. N.; Il'ichev, V. D.; Protasov, V. R.

ORG: none

TITLE: Means of animal communication and their modelling

SOURCE: AN SSSR. Nauchnyy sovet po kompleksnoy probleme "Kibernetika". Voprosy bioniki (Problems of bionics) Moscow, Izd-vo "Nauka", 1967, 419-445

TOPIC TAGS: animal, biologic model, communication signal, acoustic signal, neurophysiology

ABSTRACT: The study presents an extensive literature survey on animal chemical communication and chemoreception, communication based on light sensitivity and photoreception, acoustic communication, tactile communication and thermoreception. Any physical or chemical phenomenon produced by one organism and perceived by another organism can serve as a means of communication. There is also biological communication which includes various forms of complex activity ensuring procurement of food, reproduction, settling, care of young and intragroup and intergroup migration. Communication action mechanisms are basically divided into two types. In the first case, change of the physical or chemical properties of an environment directly affects the metabolism of an organism, and its action depends on the quantitative expression of the agent such as temperature, radiant energy or gravity. In the second case which is more complex, the acting agent has a signal value whose action does not depend on quantitative expression, but on the threshold state of the organism. In higher animals communication becomes more complex with the appearance of signal receptors and then of organs ensuring specific signalization. In addition to specialized and nonspecialized receptor systems, organisms have specific and nonspecific signalization systems. For purposes of modelling it is necessary to separate those signal elements which serve as stimuli of unconditioned reflexes, and therefore are responsible for determined forms of behavior. Actually, the part of a signal carrying the information may represent only a small part of the signal. The test for determining the elementary parts of a signal is that when these parts are isolated and reproduced, they should elicit a fully adequate response reaction. Especially important is the biological essence of a signal because this knowledge is needed for successful modelling and practical application.

327.

AUTHORS: Nedochetova, Yu. S.; Soloshchenko, N. P.; Frantsevich, L. I.; Shalimov, I. I.

ORG: none

TITLE: On the discrimination by insects of differentiation in the outlines of figures

SOURCE: AN SSSR. Nauchnyy sovet po kompleksnoy probleme "Kibernetika". Voprosy bioniki (Problems of bionics) Moscow, Izd-vo "Nauka", 1967, 124-129

TOPIC TAGS: insect, pattern recognition, conditioned reflex, probability, statistics, correlation statistics, vision, bionics, cybernetics

ABSTRACT: The possibility of insect discrimination of simple geometric figures by differentiation in their outlines is studied. Outline differentiation is defined in terms of the probability that two randomly taken adjacent elements will have identical brightness. Statistical formulas are given without derivation for one-dimensional sequences and two-dimensional figures. The figures were printed on 12 X 12-cm high-contrast photographic paper. Individually marked bees were conditioned, with the aid of sugar syrup, to land on a positive figure. One positive and four negative figures were used in the tests. Syrup was provided only after landing on the positive figure. Fresh figures were used after each landing. It is found that honey bees distinguish random figures of standard size of various statistical classes. The statistics of the image, regardless of shape, is an objective criterion for recognition. The accuracy of recognition is reduced by reducing the differences between classes. The authors thank V. A. Kovalevskiy, M. I. Shlezinger, A. Zubatenko, and R. Bershadskaya. Orig. art. has: 3 formulas, 1 table, and 2 figures.

328.

AUTHOR: Pershin, S. V.

ORG: none

TITLE: Biohydrodynamic laws of swimming of aquatic animals as a basis for optimization of the motion of submersed bodies in nature

SOURCE: AN SSSR. Nauchnyy sovet po kompleksnoy probleme "Kibernetika". Voprosy bioniki (Problems of bionics) Moscow, Izd-vo "Nauka", 1967, 555-560

TOPIC TAGS: hydrodynamics, Reynolds number, animal, bionics

ABSTRACT: The methods of the hydrodynamic similarity theory are applied to a study of the high swimming parameters of aquatic animals, which are considered to be the results of a long and elaborate evolutionary optimization process. A 4-parameter diagram is plotted on the basis of available data, for  $L$  (animal length) vs  $u_{max}$  (speed) and Re number vs  $\bar{u}_{max} = u_{max} / \sqrt{gL}$  of infusoria (spinning motion along a winding line), plankton organisms (forward rowing motion), fish (harmonic swimming motion), whales and porpoises (harmonic swimming motion), and squids

(pulsed motion), covering the Re number range from  $10^{-3}$  to  $10^8$ . The diagram shows that the maximum speed of these animals increases with their size and that the Reynolds number is an important characteristic of their motion, according to which they form 5 groups with Re  $10^{-3} - 10^{-1}$ ,  $10^0 - 10^2$ ,  $10^3 - 10^7$ ,  $10^6 - 10^8$ , and  $10^6 - 10^7$ , respectively. The principles of the evolutionary optimization of motion of aquatic animals are defined as the progressive increase of the swimming speed as an inverse function of  $\sqrt{gL}$ , a periodic economic unsteady cyclic motion hydrodynamically consistent with the structure of the boundary layer and the trailing vortex, and the tendency to minimize the number of prime movers. Orig. art. has: 1 figure and 1 table.

329.

AUTHOR: Pershin, S. V.

ORG: none

TITLE: The leaps of dolphins as a means of obtaining information on the pulse bioenergetics of high-speed aquatic animals

SOURCE: AN SSSR. Nauchnyy sovet po kompleksnoy probleme "Kibernetika". Voprosy bioniki (Problems of bionics) Moscow, Izd-vo "Nauka", 1967, 549-555

TOPIC TAGS: bionics, cybernetics, animal, bioenergetics, motion picture photography

ABSTRACT: A simple and convenient method of determining the average maximum specific pulse power of large, high-speed aquatic animals is described. Successive frames of full-scale motion pictures of the jumps of dolphins, fish, squid are processed and studied systematically. It is found that an ordinary dolphin, with a length of 2 m and a weight of 80 kg, produces a total maximum pulse power of 4 hp in 1 sec, which is twice the value usually given in the literature. Orig. art. has: 2 formulas, 2 tables, and 1 graph.

330.

AUTHOR: Poddubnyy, A. G.; Spektor, Yu. I.

ORG: none

TITLE: Investigation of migration behavior of sturgeon in a dam zone using a biotelemetric method

SOURCE: AN SSSR. Nauchnyy sovet po kompleksnoy probleme "Kibernetika". Voprosy bioniki (Problems of bionics) Moscow, Izd-vo "Nauka", 1967, 491-496

TOPIC TAGS: fish, biotelemetry, ultrasonic frequency, navigation, bionics, remote biologic recording

ABSTRACT: Field observations of sturgeon were conducted in August and September 1965 in the Volgograd Rayon. Tagged and control fish were tracked ultrasonically in pools, ponds and rivers; and, also after transfer to the upstream water of the Volga Hydroelectric Station. Transmitters (see Fig. 1) were attached to the bodies of the fish and signals were received by two antenna-converters of the same type (see Fig. 3). Following preamplification and filtration (2), the signals were heterodyned (3, 4), amplified and filtered by intermediate frequency amplifiers (5), detected and integrated (6) and fed to the comparator units (7, 8). Maximal distance of reliable reception was 600-800 m. A 12 volt accumulator battery served as a power supply, and general power consumption was 50 watts. Findings show that the motor activity of sturgeon correlates with the time of day; two maximums are noted at 04 to 08 hrs and 22 to 24 hrs, and sharply reduced activity from 12 to 19-20 hrs. Sturgeon do not move uniformly but in jerks combining fast movements with pauses. Maximum speed of the sturgeon is 10 km/hr and the mean speed is 1.0-1.3 km/hr. The sturgeon jumped out of the water at places where the characteristics of water mass and depth changed sharply. The jump was preceded by a pause in movement and was followed by a leap forward. Migrating sturgeon appear to use the same reference points for navigation. The most basic of these reference points are direction and speed of current, depth of water and water temperature. Possibly, the jumps out of the water are related to orientation. The described experiments are very similar to those staged by R. S. Trefethen, J. W. Dudley and M. R. Smith (1957) and J. H. Johnson (1960) with salmon at the Bonneville Dam, but it is difficult to compare the results because biological data are almost completely absent in the published works. Orig. art. has: 6 figures.

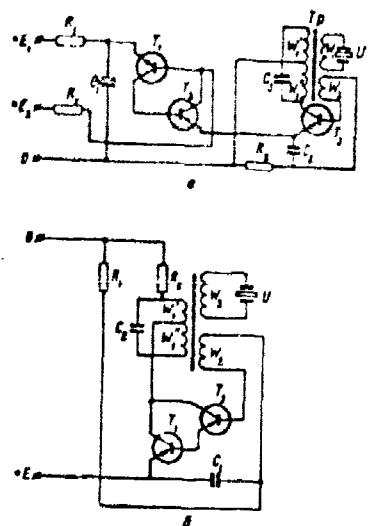


Fig. 1. Principle diagrams of ultrasonic transmitters.

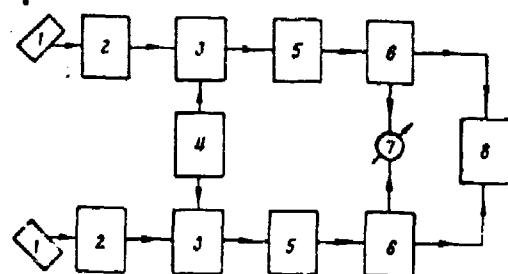


Fig. 3. Block diagram of reception part.

331.

AUTHORS: Protasov, V. R.; Podlipalin, Yu. D.; Krumin', V. M.

ORG: none

TITLE: The role of gravitation waves in the orientation of fish

SOURCE: AN SSSR. Nauchnyy sovet po kompleksnoy probleme "Kibernetika". Voprosy bioniki (Problems of bionics) Moscow, Izd-vo "Nauka", 1967, 475-491

TOPIC TAGS: bionics, cybernetics, gravitation wave, water, navigation system, biopotential, electrophysiology, conditioned reflex

ABSTRACT: Data obtained in a study of the reception of gravity waves by fish in water are discussed in connection with aspects of bionics and fish behavior. Various cases of the mechanical interaction of a fish body with a medium perturbed by gravitation waves are examined, and experiments with a number of fish in tanks and the apparatus for creating and recording gravitation waves are described. The biopotentials of the fish were recorded in the tests where the sensitivities of the fish to gravitation waves were determined with the aid of conditioned reflexes. It is found that gravitation waves together with other factors are an orienting stimulus in the migrations of aquatic animals. Apparatus based on this principle could be used to attract or frighten fish and for short-range prediction of the distribution of commercial fish.  
Orig. art. has: 15 formulas, 10 figures, and 3 tables.

332.

AUTHOR: Sakayan, A. R.

ORG: none

TITLE: Study of carrier pigeon orientation

SOURCE: AN SSSR. Nauchnyy sovet po kompleksnoy probleme "Kibernetika". Voprosy bioniki (Problems of bionics) Moscow, Izd-vo "Nauka", 1967, 510-514

TOPIC TAGS: bird, earth magnetic field, behavior pattern

ABSTRACT: Lack of objective criteria to complement the experience and intuition of the pigeon breeder is indicated, on the basis of the state of the art, in assessing the homing capability of carrier pigeons. It is further indicated that the probability of positive results for the orientation property of the hybrid offspring is generally much lower than the probability of negative results when both parent species have combinations of different high orientation characteristics, such as (1) sharp high-resolution vision, strong memory for familiar local orientation marks, and an inborn or training-developed terrain-guided homing algorithm, and (2) a highly developed sense of time, and a solar

position oriented homing algorithm. It is pointed out, on the other hand, that navigation properties are well inherited in old steady pigeon breeds. 1.5 x 50 mm cylindrical magnets, weighing 0.7 G and producing a 0.15-0.2 oe magnetic field, were attached longitudinally to the backs of 4 carrier pigeons with a good orientation heredity in a study of the possible magnetic background of their orientation function, which was conducted in summer 1965 between Moscow and points 601 and 720 km SWW. The ratio between the straight line distance and the actual flight distance was used as an orientation criterion in the evaluation of the results, assuming an 80 km/hr flying speed. In 6 out of a total of 7 flights, the birds, released alone or accompanied by control birds, reached their Moscow destination point under these magnetic disorientation conditions. They showed a very good orientation criterion of less than 0.01, with the exception of one bird that lost his magnet and showed a criterion of just 0.01. Conclusions of Riper and Kalmbach (1952), who dismiss magnetic orientation in pigeons, and Talkington (1964), Kupke (1965), and Yeagley (1947, 1951) who support it, are disputed as insufficiently founded. Orig. art. has: 1 table.

333-

AUTHOR: Shumakov, M. Ye.

ORG: none

TITLE: Experiments in determining the possibility of magnetic orientation in birds

SOURCE: AN SSSR. Nauchnyy sovet po kompleksnoy probleme "Kibernetika". Voprosy bioniki (Problems of bionics) Moscow, Izd-vo "Nauka", 1967, 519-523

TOPIC TAGS: bird, behavior pattern, earth magnetic field

ABSTRACT: The possibility of magnetic orientation was studied in October 1964 in birds of the *Fringilla coelebs*, *Erythrina erythrina*, *Emberiza hortulana*, *Sylvia atricapilla*, and *Erithacus rubecula* genuses on a theory that birds under conditions of oriented migration activity may change, in the positive case, their direction in the presence of a strong magnetic field when the direction of the field is different from that of the geomagnetic field. The directivity of migration activity of a group of 23 birds, captured on the Baltic sea shore during migration and confined in circular cages free of intrinsic magnetic effects, was

determined by the author's method (Sbornik Bionika, Moscow, 1965) at the site of capture and on the following day, at the town of Gubkin in the center of the Kursk magnetic anomaly, where the angle between magnetic and geographic northerly directions is 60°. At the site of capture, all birds showed a clearly pronounced migration anxiety, oriented in the direction of migration in clear weather and showing no orientation pattern in the presence of a solid cloud cover. In contrast, no orientation pattern could be established in the magnetic anomaly region, even though all birds showed an activity 2-3 times higher than on the Baltic Sea shore, as indicated by the author's migration activity diagrams. Orig. art. has: 1 figure.

334.

AUTHOR: Shtegman, B. K.

ORG: none

TITLE: Automation of the motions of the bird wing

SOURCE: AN SSSR. Nauchnyy sovet po kompleksnoy probleme "Kibernetika". Voprosy bioniki (Problems of bionics) Moscow, Izd-vo "Nauka", 1967, 539-543

TOPIC TAGS: bird, muscle physiology, skeletal mechanics, aerodynamic force

ABSTRACT: The mechanism of coordination and conjugation of the muscular motion of wings of present birds is analyzed. The functionally conjugated wing muscles and bands participating in the automatic coactivation of wing elements in flight are identified as extensor metacarpi radialis (transferring the bending motion from the wrist joint to the elbow joint and vice versa), flexor carpi ulnaris and flexor metacarpi ulnaris (transferring the bending motion of the elbow to the wrist), and the humerocarpal band producing with another band the involuntary bending and unbending of the wrist when the elbow is bent or unbent, and vice versa. Also discussed are aerodynamic conditions producing wing torsion, a condition under which the wing root preserves a positive angle of attack while the wing tip constitutes a propelling surface producing thrust which is conveyed from there to the body. It is also noted that the forceful downward motion of wings activated their skeletal and muscular system to produce automatically both torsion and thrust so that only the large thorax muscle is active in their downward motion, while their upward motion is completely passive. The absence of automation of motion in archeopteryces is pointed out. Orig. art. has: 7 figures.

335.

AUTHOR: Yakobi, V. E.; Mantayfel', B. P.

ORG: none

TITLE: Present problems of bionic investigations of orientation of migrating animals

SOURCE: AN SSSR. Nauchnyy sovet po kompleksnoy probleme "Kibernetika". Voprosy bioniki (Problems of bionics) Moscow, Izd-vo "Nauka", 1967, 468-475

TOPIC TAGS: fish, bird, bionics, orientation, navigation

ABSTRACT: The study presents an extensive literature survey on the orientation based on astronavigation, earth's magnetic field, special receptors and other factors is confirmed by some of the cited sources and denied by others, but the authors do not favor any particular theory. Orientation and navigation of birds and fish are of great interest to bionics because of the high accuracy of navigation and high degree of reliability provided by a relatively small brain volume. To a certain extent the problem is related to form recognition. To investigate the astronavigation mechanism of birds, it is necessary to understand how a bird separates the useful signal, what characteristics or group of characteristics of the constellations or shifting of the sun are perceived, whether the brain is capable of making the corresponding extrapolations and computations for purposes of navigation, and what role memory plays. A solution of these problems may help produce optimal variants of navigation instruments and electronic computers. Investigation of the orientation and navigation of animals should contribute to the production of technical devices for controlling animal populations, for frightening or attracting animals and for controlling animal movements and behavior. The authors do not express any opinions or draw any conclusions on the material presented.

330.

AUTHORS: Zingerman, A. M.; Samarskiy, V. I.

ORG: none

TITLE: The orientation reflex and the problem of optimal variation of the control algorithm of a living system

SOURCE: AN SSSR. Nauchnyy sovet po kompleksnoy probleme "Kibernetika". Voprosy bioniki (Problems of bionics) Moscow, Izd-vo "Nauka", 1967, 368-373

TOPIC TAGS: bionics, cybernetics, probability, reflex activity, algorithm, control system, optimal control, brain, reliability, error, adaptation, neuron, nervous system, nerve cell

ABSTRACT: The literature on the orientation reflex and optimal variation of the control algorithm of a living system is surveyed briefly. Von Neuman's hypothesis of a multiple structure of the nervous system of higher animals is employed to determine the number pulses that circulate in the brain from one error to another, the probability of incorrect response to an indefinite, new situation, and brain reliability. Structures of the orientation reflex are considered to have the lowest stimulation threshold. The following sequence of operations in autonomous control systems with low a priori information on the medium is proposed: extraction of signals from the controllable parameters of the medium; primary recognition of these signals and determination of their significance using memory; adjustment of the measuring complexes to the required sensitivity and accuracy; adoption of solutions provided by the program; variation of the analysis algorithm when a signal is not recognized at the stage of deterministic logic; and adoption of a solution with determination of its reliability. Orig. art. has: 4 formulas.

SECTION F. BIOPOTENTIALS AND BIOELECTRIC CONTROL SYSTEM STUDIES

337.

THE PROCESS OF RELEARNING COMPLEX MOTOR ACTIONS IN PATHOLOGICAL CONDITIONS BY MEANS OF A BIOELECTRIC CONTROL SYSTEM WITH FEEDBACK

ORG: Institute of Cybernetics, Academy of Sciences UkrSSR  
(Institut kibernetiki AN USSR)

Aleyev, L. S., and S. G. Bunimovich. Mezhvuzovskaya nauchnaya konferentsiya po neyrokibernetike, 2d, Rostov-on-Don, 1965. Problemy neyrokibernetiki (Problems of neurocybernetics); materialy konferentsii, v. 2, Rostov-on-Don, Izd-vo Rostovskogo univ., 1966, 114-116.

AT7033543

The electrical activity of muscles during a voluntary motor act represents a stimulating process in all parts of the complex motor path from the cortical terminal of the motor analyzer to the operative units.

Preliminary experiments were conducted and various models of a device were developed, which portrayed the physiological features of motor actions as accurately as possible. The results of preliminary experiments permitted the construction of an operative model of a control device utilizing multichannel action. The bioelectrical potentials developed by the donor during a given motor act are registered by surface electrodes from the motor points which correspond to a given group of muscles. These signals are amplified and are then fed to a magnetic tape unit or directly to the next stage of the device, the integrating unit. Signals previously recorded in the magnetic tape unit can also be fed to the integrating unit, as can signals coming directly from the input amplifier. The integrating unit determines the mean value of the myogram as a function of time; the time constant may vary. The signal, which appears as a curve describing the mean value of the myogram for a certain interval, is fed to a rectifier, which also receives a signal from the standard generator of the stimulating impulses. As a result, a signal which corresponds in form to the signal from the generator and is proportional in amplitude to the mean value of the myogram is received at the output. The device includes a control and tracing unit which allows simultaneous visual observance of the processes in the various subassemblies of the device by means of a multichannel oscilloscope. Thus, necessary corrections can be made.

The electric potentials recorded from the muscles, which form the algorithm of movement, guide the artificially formed signal which is fed to the recipient's analogous muscles or groups of muscles. With proper selection of amplitudes for the stimulating signals, the

recipient may be made to move synchronously with the donor. The magnetic tape unit can repeat the recorded algorithm continuously, or can provide for a preliminary arrangement to generate given movements. The presence of the stimulating signal generator allows the duration of the controlled stimuli to be altered; this is extremely important during stimulation in various periods of change in the functional state of the stimulated objects. The design of the device allows the stimulating signal generator to be used interchangeably with sources of signals of varying form. Each channel of the device is independent and has three work regimes: 1) recording the movement algorithms on the magnetic device; 2) feeding control signals from the magnetic tape unit; 3) feeding control signals directly from the donor, bypassing the magnetic tape unit.

Movement is induced by nonpolarizing electrodes (with hydrophilic interlayers) which are applied to the motor points of the corresponding muscles.

Preliminary results of a clinical test of this device confirmed the authors' suppositions. The device enables motor action control programs to be prepared for both healthy donors and convalescents.

A study was conducted at the Neurology Clinic of the Kiev Medical Institute on 50 patients with residual effects of nervous system diseases. In the majority of patients, the source of trouble was in the area of the cortical motor analyzer. Etiopathogenetically, these were, on the whole, residual effects of vascular disorders in the brain. To judge the effectiveness of treatment, electroexcitability and electromyography before and after treatment were compared. Force and movement were also evaluated.

At the present time, it is very acceptable to employ the law of variation of the summary neuromyogram's mean value in a multichannel system as a controlling signal. [AC]

338.

#### SIMULATION — AN INSTRUMENT OF PROGNOSIS AND CONTROL

Amosov, N. Nauka i zhizn', no. 7, 1967, 46-54.

AP7024524

Schematic representations and general discussions are given for cybernetic models of various systems. A "world" system is treated, taking into account the interaction of society with the material world and the world of nature, with special attention given to the interrelationships between society and various world models, both

static and dynamic, all of which are based on "coupling" with the present and future. A hypothetical human model is explained (Fig. 1).

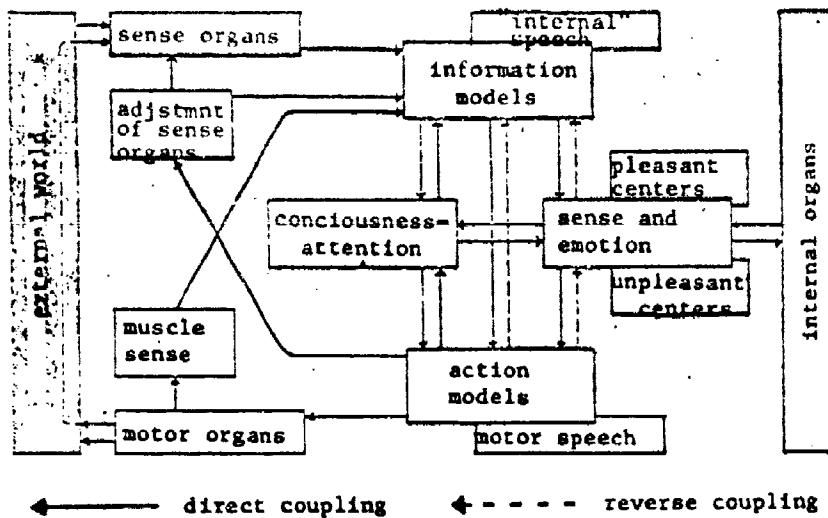


Fig. 1. Hypothetical scheme of a human model.

A scheme for evaluating the degree of happiness is discussed as well as a model of society in relation to the future. A qualitative tabulation is made of various instincts, reflexes, and direct and derived senses together with their response to training and their effect on society. [26]

339.

AUTHOR: Chernitser, V. N.

ORG: none

TITLE: Choice of a time compressor for a low frequency spectrum analyzer of biopotentials

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 160

TOPIC TAGS: EEG, biopotential, spectrum analyzer, magnetic recorder

ABSTRACT: A system consisting of a time compressor and a spectrum analyzer with sequential action is the most rational apparatus for EEG spectral analysis in the range of subsonic frequencies. Use of the time compressor ensures a multiplicative

transfer of the spectrum of investigated frequencies which reduces analysis time and increases resolving capacity. Choice of the type of time compressor and determination of its basic parameters are important factors in designing such equipment. Study of the action principles and the basic features of time compressors with dynamic and static storage memories led to conclusions about the advisability of using time compressors with magnetic recording for EIG analysis.

340.

AUTHORS: Gidikov, A. A. (Bulgaria); Tomov, I. I. (Bulgaria); Baramov, N. Kh. (Bulgaria)

ORG: none

TITLE: Some investigations to refine a model of the control system of human motor responses

SOURCE: AN SSSR. Nauchnyy sovet po kompleksnoy probleme "Kibernetika". Voprosy bioniki (Problems of bionics) Moscow, Izd-vo "Nauka", 1967, 373-381

TOPIC TAGS: cybernetics, bionics, model, biologic model, analog computer, control system, nervous system, adaptation / Analog 1 analog computer (U)

ABSTRACT: The servo motions of the human arm are investigated. The work was done to check a model based on the assumption that structures producing discreteness of the mechanogram can be approximated by an element with a pure delay. The operator sees a signal moving at a constant velocity and attempts to follow it with the aid of a scribe (see Fig. 1). A generalized model (see Fig. 2) and a circuit for its realization on an Analog-1 computer are given. The results of the modeling allow it to be assumed that adaptation to the characteristics of the signals and of the device for following them is accomplished in the nervous system by independent mechanisms and at different levels. The applicability of quasi-linear models for describing this control system is explained.

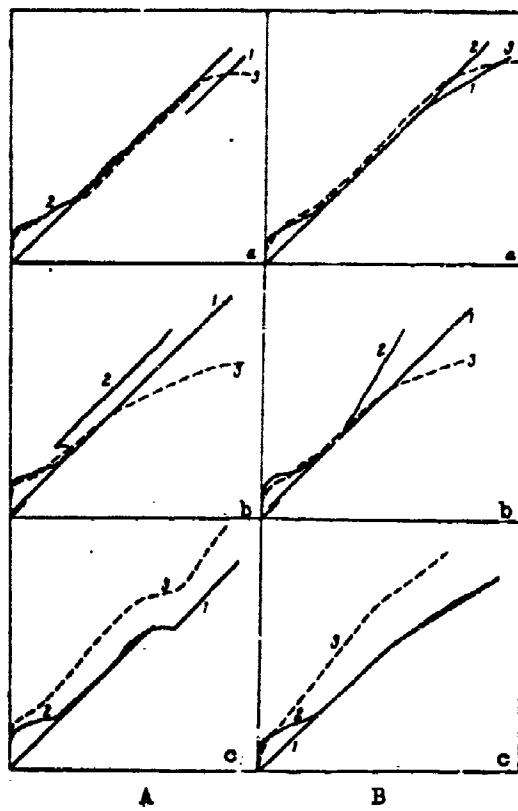


Fig. 1. Test results: 1 - signal;  
2 - artificial result; 3 - actual  
result of reaction

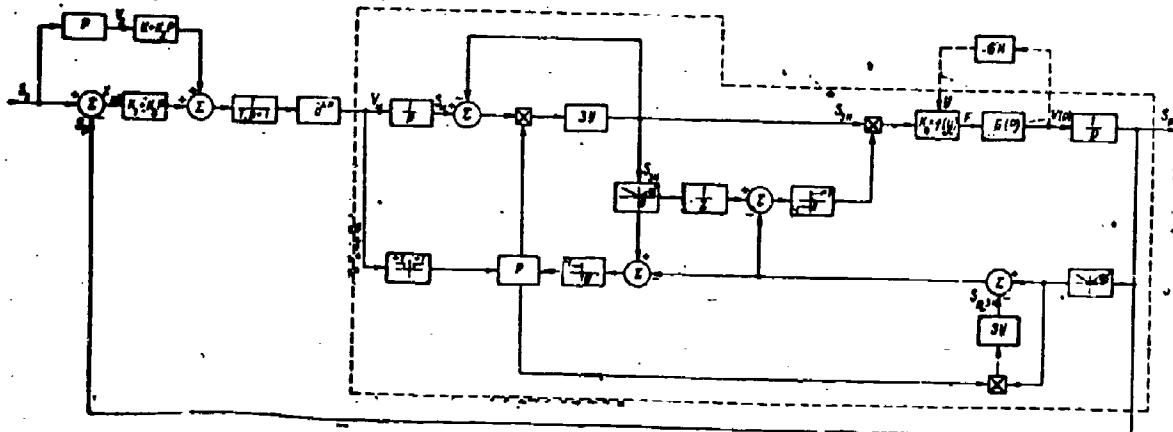


Fig. 2. Generalized model of control system of human servo movements

Orig. art. has: 7 figures, 8 formulas, and 1 table.

341.

AUTHOR: Kashevskiy, V. V.

ORG: none

TITLE: Transposition of the spectrum of frequencies during analysis of biomeasuring information signals

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 62

TOPIC TAGS: biopotential, signal transmission, spectrum analyzer, magnetic recording

ABSTRACT: Signalograms of biopotentials are complex in form and are mixtures of useful information and noise. In most cases their visual evaluation is extremely difficult and requires considerable time, but they can be objectively evaluated by spectral analysis. However, spectral analysis of subsonic frequencies can also take considerable time. Recently a sequential action spectrum analyzer in combination with a transposing device based on magnetic recording was successfully used for reducing analysis time and improving resolution of frequencies. There is considerable interest in utilization of such spectrum analyzers during transmission of signals in networks of biomeasuring information with different kinds of modulation. The present report examines the application of transposing devices with different kinds of modulation, presents expressions for their spectra, analyzes the expressions to draw conclusions on the choice of modulation, and makes recommendations on the parameters of the transposing device and the spectrum analyzer.

342.

A UNIT FOR INFORMATION PROCESSING AND THE GENERATION OF ASSIGNED FUNCTIONS IN A BIOELECTRIC CONTROL DEVICE

ORG: none

Khayfets, I. M., A. V. Trubetskoy, A. V. Gusarov, and V. V. Konyayev.  
Class 30, No. 200715. Izobreteniya, promyshlennyye obraztsy,  
tovarnyye znaki, no. 17, 1967, 64. AP7029923

An Author Certificate has been issued for a device for information processing and the generation of assigned functions. It is equipped with a set of frequency meters for monitoring bioelectric impulses, quadripole leads with controlled nonlinearity and a transmission coefficient, so that any control devices may be used, and synchronized with the varying rhythms of phases of bioelectric activity in the organism; a perfusion pump, for example, might be synchronized with the phases of the cardiac cycle. UDC: 615.847:615.12-073.97 [AC]

343.

AUTHOR: Kolesnikov, G. F.; Palenko, A. A.; Pirogov, V. A.

ORG: none

TITLE: A method of electric stimulation of neuromuscular structures

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 68

TOPIC TAGS: muscle stimulation, bioelectric control, neurophysiology, electromyography, proprioception, sensory motor area

ABSTRACT: Bioelectrically controlled stimulators can be used to activate a considerable number of neuromotor units, which is important for providing the proper functional state of the human motor apparatus under conditions such as prolonged limited mobility. Performance of specified work by different muscles under periodic electric stimulation according to a specific program is a kind of analog to physical training. The effect of threshold electric signals, which do not induce contraction of the muscles, on the functional condition of neuromuscular structures was studied in the course of research on optimal parameters under different conditions of stimulation. A rise in efficiency compared to the control group was established.

in several series of experiments with subthreshold stimulation of a neuromuscular apparatus during performance of dynamic or static work. Electric stimulation with subthreshold impulses for one month increased the strength and excitability of muscles. The data was analyzed on the basis of electromyograms, the integral electric activity of the muscles, ergograms, and other indices. Afferent stimulation is connected with the capacity of receptors (including proprioceptors) for prolonged response to impulse stimulation. In this connection, feedback is formed through spinal motor neurons of like segments, i. e. efferent impulsion arising in response sustains muscular tonus and trophic processes on a higher level than at rest.

344.

INVENTOR: Levin, Ya. V.; Sanin, V. G.; Khrapovov, V. A.; Korotkov, A. I.

ORG: none

TITLE: Device for determining inner contours of the cross sections of the prosthesis receiving sleeves. Class 30, No. 207326 [announced by the Central Scientific Research Institute of Application and Construction of Prostheses (Tsentral'nyy nauchno-issledovatel'skiy institut protezirovaniya i protezstroyeniya)]

SOURCE: Izobreteniya, promyshlennyye obraztsy, tovarnyye znaki, no. 2, 1968, 49

TOPIC TAGS: prosthetic device, prosthesis

ABSTRACT: This Author Certificate introduces a device (see Fig. 1) consisting of a support and stand for determining inner contours of the cross sections of the prosthesis receiving sleeves. To obtain noncontact single-moment contours at any level of the stump receptors, the stand is equipped with a linear scale and a camera carrying sliding cantilever arm with rod on its free end on which the level recorder is fastened, e.g., in the shape of the slit-type illuminator. [Translation of patent abstract] [WA-A-68-38] [NT]

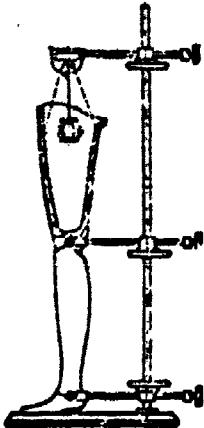


Fig. 1. Device for determining inner contours of the cross sections of the prosthesis receiving sleeves

345.

AUTHORS: Medelyanovskiy, A. N.; Tabarovskiy, I. K.

ORG: none

TITLE: Automatic prosthesis of a system for maintaining homeostasis

SOURCE: AN SSSR. Nauchnyy sovet po kompleksnoy probleme "Kibernetika". Voprosy bioniki (Problems of bionics) Moscow, Izd-vo "Nauka", 1967, 328-337

TOPIC TAGS: cybernetics, bionics, biologic model, automatic control, automatic control system, homeostasis, biologic respiration, blood circulation, heart, carbon dioxide, oxygen, blood pressure

ABSTRACT: Automatic systems for controlling artificial blood circulation and artificial respiration are described employing a model of the functions of a natural system. The interrelationship of the indices of the internal medium, which ensures activity of the central nervous system and its organism, and the central mechanisms controlling the levels of the indices is found to be of greatest significance. A combination of the described systems for controlling perfusion and respiration in conjunction with the narcosis apparatus and aerator can ensure automatic regulation of the vitally important functions in man in all possible cavity and cranial operations. Orig. art. has: 6 figures.

346.

PRINCIPLES OF CONTROL OF MACHINES AND LIVING ORGANISMS BY MUSCULAR BIOPOTENTIALS

ORG: none

Moretskiy, A., Yu. Ekel', and K. Fidelyus. Moscow. Institut mashinovedeniya. Mekhanika mashin, no. 7/8, 1967, 129-138. AT7028890

A "living model" was developed which is capable of exact repetition of any program transmitted to it by a living organism by wire or radio. The electromechanical and biomechanical principles of controlling the group of muscles in the upper extremity are discussed, and the following assumptions are given as a basis for control of a muscle or a group of muscles by coded biopotentials: 1. The functions of the same muscles in the controlling and controlled extremities are identical. 2. Control of individual muscles and even of individual motor units is possible; within certain limits, the relationships between force, velocity, muscle length, and stimulus parameters are nearly linear. 3. The force developed by the controlled muscle is proportional to that developed by the controlling muscle (or the amplitude of the stimulating current). It is shown that a decoded myogram carries information on the power of a neural signal depending on the length of a muscle and its force potentialities. A system is described for using one arm to control the muscles of the other with simultaneous measurement of the biopotentials and force developed by the controlling arm, and bending and flexure of the controlled arm. A series of tests on stimulation of individual muscles and groups of muscles showed the feasibility of parallel stimulation of 5 muscles and series stimulation of 15 muscles with resultant motions which are close to natural. Detailed studies of stimulus parameters show that coding of muscular biopotentials is superior to direct tapping of biopotentials as a physiological control method. It was found that the initial conditions and the measures taken to counteract the force of gravity are important factors in the control process. Studies in the field of multiple-stage equipment showed that many problems may be successfully solved by using a binary control system. The problem of delay in the controlled limb from the standpoints of position and force is also important in the control process. The feedback problem (position, velocity, and force) must be solved on a separate basis.

347.

AUTHOR: Palenko, A. A.; Kolesnikov, G. F.

C&G: none

TITLE: Bioelectronic control system with crossed feedbacks

SOURCE: Vsesoyuznaya konferentsiya po neirokibernetike, 31, Rostov-on-Don, 1967. Problemy neirokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 110-111

TOPIC TAGS: bionics, automatic control system, bioelectric control, electronic feedback, muscle stimulation

ABSTRACT: Study of the electric activity and characteristics of human neuromuscular structures has demonstrated a real possibility for creation of bioelectronic system to control both neuromuscular apparatuses and technological devices under different conditions. The authors developed and investigated a two-channel system with cross feedbacks for control of movements in one plane. Bioelectric signals were used after appropriate processing to control the activity of cascades of the stimulator. Cross feedbacks reproduce a movement by affecting a pair of antagonistic muscles. A twelve-channel system was similarly developed. The forming device of the stimulator develops pointed impulses with a regulated duration and frequency of sequence. A functional and line diagram and features of operation under automatic control conditions were examined. Problems of the choice of optimal characteristics of individual assemblies and utilization of the system in clinical practice and in control of technological devices are considered.

348.

EVALUATION OF GRASPING FORCE BY A PERSON USING AN ARTIFICIAL HAND

ORG: none

Shneyder, A. Yu. Moscow. Institut mashinovedeniya. Mekhanika mashin,  
no. 7/8, 1967, 84—96.  
AT7028889

The author considers the problem of "feeling" the force of grasping through the fingers of an artificial hand in connection with the development of manipulators for technology and prostheses. Methods for automatic and active control of grasping pressure by feedback are discussed, as well as the recent development of devices controlled by the bioelectric potential of the skeletal muscles. This type of control is superior to manual control with external feedback from the standpoints of dynamic characteristics and precision. Localized vibration is selected as the most suitable means for introducing feedback to indicate grasping pressure in an artificial hand utilizing the bioelectric potential of skeletal muscles. The problems of irritation and fatigue are minimized by using vibration in the feedback system in place of other "sensory input" signals such as pressure. A pulse-frequency system is recommended in which the variable parameter is the prf (1-40 pulses per second) with a constant duration of 10 msec and an amplitude of no more than 0.45 mm. Tests were conducted on ten subjects experienced in handling bioelectric controls but unaccustomed to recognition of a vibrational stimulus. Visual and vibrational signals were used for indicating grasping force in an artificial hand. The visual signal was a bright spot on the screen of an oscilloscope moving with a ratio of 100 g/cm, while a mechanical vibrator was used as the vibrational indicator with a ratio of 115—120 g/pulse/sec. The actual grasping force was registered on an oscillograph by a pressure pickup which was pinched between the thumb and index finger of the artificial hand. The subject's task was to respond as rapidly as possible to a visual command (neon light) by tracking a given grasping pressure. Accuracy was determined by calculating the systematic error and random error. The ratio of the random error to the given tracking level was taken as the relative error of the subject. The results show that vibrational feedback may be used for accurate judging of the grasping force in the fingers of an artificial hand.

349.

AUTHOR: Voytinskiy, Ye. Ya.; Pryanishnikov, V. A.

ORG: Leningrad Scientific Research Institute for Childhood Infections (Leningradskiy nauchno-issledovatel'skiy institut detskikh infektsiy)

TITLE: Multichannel transistor analyzer for measuring the distribution function of brain and muscle biopotentials

SOURCE: Meditsinskaya tekhnika, no. 6, 1967, 14-18

TOPIC TAGS: distribution function, multichannel analyzer, probability distribution, electrocardiography, electromyography, electroencephalography

ABSTRACT: Valuable information on the normal or pathological behavior of an organism can be obtained by measuring the distribution function of the biopotential amplitudes. Errors in graphic differentiation of distribution curves can amount to 15-20%. A simple 20-channel transistor analyzer is described which permits continuous registration of probability density of EEG or ECG biopotentials. A continuous EEG signal is converted by an amplitude-pulse modulator to a sequence of pulses whose amplitude is proportional to the instantaneous value of the signal. Pulse length =  $10^{-4}$  sec, pulse repetition = 1 msec. Pulses are advanced to the amplifier to be intensified to values sufficient for normal operation of the selector levels. The level selectors select pulses whose amplitude exceeds the discriminator threshold, determined by the amplitude of the input signal, with amplitude level determined in each selector. The number of selectors determine the number of simultaneously recorded distribution function values. Pulses from selector output advance to the shaper where pulses are converted to pulses of like amplitude and duration. The mean value of the pulse potential from the shaper output for a given time interval is determined by the integrator. The potential from the output of two adjacent channels advances to the d. c. amplifier, whose output potential is recorded on a potentiometer. The difference in the potential from the neighboring channels is proportional to the probability density value. The accuracy of the probability density measurement dep. 's on integration time (on the number of cumulative pulses N); at  $N = 10^4$  pulses accuracy =  $\pm 2\%$ . The sensitivity of the analyzer and its input resistance are such that they compare with the output of the different biopotential amplifiers. Basic circuits for the amplitude-pulse modulator and pulse amplifier and for one of the measuring channels are included. The small and light weight transistor analyzer may be used in experimental and clinical electrophysiology for analyzing electroencephalograms and electromyograms. Orig. art. has: 4 figures and 3 figures.

350.

TEST SETUP FOR BIOELECTRIC CONTROL SYSTEMS

ORG: Central Scientific Research Institute of Application and Construction of Prostheses, Moscow (TSentral'nyy nauchno-issledovatel'skiy institut protezirovaniya i protezostroeniya)

Yezhov, M. D. Class 30, No. 196249. Izobreteniya, promyshlennyye obraztsy, tovarnyye znaki, no. 11, 1967, 68. AP7020674

Development is reported of a device for testing the reliability and durability (failure-free life) of bioelectric control systems under conditions simulating actual use. The test device consists of cutout time relays, commutator switches, a calibrated signal source (cold cathode thyratron multivibrator with a ladder-type RC-filter at the output), and a reverser (electromagnetic relay with auto-oscillator connected to a counter based on a trigger circuit). [DP]

UDC: 615.471:616-089.28:612.014.421

## SECTION G. BIOLOGICAL REGULATORY SYSTEMS

351.

AUTHOR: Abdurakhmanova, R. R. (Samarkand)

ORG: none

TITLE: Effect of the vestibular analyzer on regulation of blood coagulation

SOURCE: Konferentsiya fiziologov Sredney Azii i Kazakhstana, 3d, Dushanbe, 1966. Materialy. Dushanbe, 1966, 7-8

TOPIC TAGS: man, vestibular function, vision physiology, peripheral circulation, blood coagulation

ABSTRACT: Change in the blood coagulating system and in the composition of formed elements of peripheral blood at the time of postrotatory nystagmus (ten revolutions in 20 seconds in a Barany chair) was studied in 74 healthy subjects. Blood for investigation was taken from a vein in the forearm before rotation and at the moment the chair stopped. As a result of the investigations different effects of stimulation of the vestibular apparatus on blood coagulation were noted. All subjects were divided into three groups according to these effects. Persons with reduction of coagulation time (58.1 percent of those examined) were included in the first group, persons with prolongation of blood coagulation time (37.9 percent) were included in the second group, and the third group consisted of only three persons (4 percent) with no changes in blood coagulation. The changes which occurred during tests with a background of excitation of the vestibular analyzer tended in the first group toward an increase in activity, with the exception of fibrinolytic activity of the blood, and in the second group tended toward reduction in the activity of the investigated factors, with only the fibrinolytic activity of the blood increasing. There were no regular changes in the third group and the results here proved to be unreliable. The quantity of formed elements of the peripheral blood (erythrocytes, leukocytes, thrombocytes) decreased as a rule. The data obtained are statistically reliable and it appears that the vestibular analyzer participates in the regulation of the blood coagulation process.

352.

AUTHOR: Agapov, B. T. (Kiev); Gorshinskaya, N. A. (Kiev); Mokhort, L. G. (Kiev)

ORG: none

TITLE: Nature of the dependence of cardiac output on pressure in the right atrium of the heart

SOURCE: Seminar "Nekotoryye problemy biokibernetiki i primeneniye elektroniki v biologii i meditsine", Doklady, no. 2, 1967, 59-73

TOPIC TAGS: heart, linear function, blood pressure, mathematic model

ABSTRACT: Investigation of the functional dependence of cardiac output on pressure in the right atrium of the heart is important for understanding the regulation mechanism of heart productivity and is essential for a quantitative description and formation of a mathematical model of heart functioning. In experiments on a heart-lung preparation (details not given) the authors found both linear and nonlinear types of dependence in determining the venous characteristics expressed by  $N = f(P_{nn})$ , where  $N$  is the output developed by the heart and  $P_{nn}$  is the pressure in the right atrium of the heart. Linear dependence is simpler for analyzing regulation of heart productivity and is also simpler for mathematic and analytic modelling of the work of the heart on an electronic computer. Nonlinear dependence is more difficult for describing the functioning law of the heart because it is necessary to assume that the regulation mechanisms of the heart are of a nonlinear nature. The nonlinear dependence is more difficult to use for analytic modelling, but from a physiological point of view it offers wider possibilities for qualitative analysis and explanation of the work of the heart. On the basis of twenty approximations in thirty experiments, findings show that with a high degree of proximity ( $\Delta \leq 6\%$ ) the basic pumping function of the heart working under automatic conditions with a constant functional state can be approximated by the linear dependence  $N = aP_{nn} + b$ , where  $P_{nn} \in [15.100] \text{ mmH}_2\text{O}$ . A more careful analysis of experimental data and stricter identification of the characteristics ( $\Delta \leq 3.5\%$ ) leads to the approximation of function  $N = f(P_{nn})$  with the exponential dependence of the form  $N = N_{\max} / [1 - e^{-m(P_{nn} - P_0)}]$ . In the study it is proven that the exponential form of the dependence is not connected with change of the functional state. Nonlinear dependence is found repeatedly, just as well as linear dependence, and preserves its form (coefficients  $N_{\max}$ ,  $m$  and  $P_0$ ) within wider limits than for linear dependence. Coefficients of the exponential approximating expression are well interpreted from the point of view of their physiological significance and facilitate analysis of the regulation mechanism of heart productivity. Orig. art. has: 4 figures, 1 table and 5 formulas.

353.

AUTHOR: Al'bertinskiy, B. I.; Kan, Ye. L.

ORG: none

TITLE: The mechanism for maintaining stability of erythrocyte balance as a biocybernetic system

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 5

TOPIC TAGS: erythrocyte, homeostasis, hemostasis, oxygen consumption, biocybernetics

ABSTRACT: The oxygen consumption level in tissues of living organisms is controlled in relation to external factors by a complex automatic control system in which functions of several regulation and control subsystems are comparatively clearly defined. Among them the subsystem ensuring erythrocyte balance has a particular specificity, based mainly on a considerable lag during inclusion, significant inertness with removal of load, necessity for presence of two input signals (the neural and humoral signals) for obtaining a response reaction, and the blocking of input of low-speed controlling structures in the presence of a signal at the output of high-speed controlling elements. The special features of the erythrocyte balance subsystem are illustrated by examples from the authors' investigations and by results from the literature. Analysis of this subsystem and its role in the activity of a more complex formation leads to specific hypotheses about the nature of the hierarchy and the interrelationships between separate levels of regulation in the homeostatic mechanism of a living organism.

354.

AUTHOR: Amosov, N. M.; Lishchuk, V. A.; Berezovskiy, B. A.; Filanovskaya, A. N.

CRG: none

TITLE: Self-regulation in the blood circulation system

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 6

TOPIC TAGS: hemostasis, hemodynamics, heart, cardiovascular system

ABSTRACT: A mathematical description of hemodynamics examined in the literature includes regulation at the level of the central nervous system. In 1966 a model for self-regulation of the heart was proposed by the authors. Analysis of this model led to identifying a number of general characteristics determining the direction of reaction of the heart to the most varied actions. Interpretation of these characteristics of self-regulation of the heart from the viewpoint of blood transport control led to: a) a classification of operating conditions of the blood circulation system according to optimization criteria; b) evaluating the role of central nervous and humoral regulation of the blood circulation system for various conditions; c) predicting a number of correlative interrelationships between hemodynamic parameters; and, d) evaluating the role of prediction for individual operating conditions of the blood circulation system. The report generalizes on the results and offers initial premises for organizing a system for blood circulation regulation.

355.

AUTHOR: Batuyev, A. S.

CRG: none

TITLE: The motor analyzer as a system of self-regulation and interanalyzer integration

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 10-11

TOPIC TAGS: sensory motor area, self regulation, neuron, muscle physiology, central nervous system

ABSTRACT: The morphological and physiological construction of a motor analyzer has not been clearly determined. A concept exists concerning its exclusively afferent nature (Gamkaryan). L. A. Kukuyev develops a point of view concerning its afferent-efferent links. A point of disagreement is the function of the pyramidal system. It is well known that the pyramidal system provides cortical influences on the α - and γ-motor neurons of the spinal cord. Together with its function of regulating

voluntary motor activity, the pyramidal system regulates the muscle receptors through the  $\gamma$ -motor neurons (Granit) and regulates the flow of background afferent pulsation to the spinal neurons through the mechanism of presynaptic inhibition (Kostyuk). Consequently, the pyramidal system fulfills the function of self-regulation within the motor analyzer, the same as any other analyzer that includes in its structure feedbacks from centers to receptors. Each analyzer, including the motor analyzer, operates according to the principle of the neural ring. However, the distinguishing feature of the motor analyzer is that the pyramidal system serves as the general pathway for cortical influences on the spinal neurons, the different subcortical nuclei of the analyzers, and the reticular formation of the stem. The cortical giganto-pyramidal area is not only a projection of the motor analyzer, but also is the funnel-focus of convergence of the different analyzer systems (Ukhtomskiy). Both of these factors are basic to the fact that the motor analyzer is the most important cerebral apparatus for interanalyzer integration.

356.

AUTHOR: Borgardt, A. A.

ORG: none

TITLE: Self-regulation in systems having many elements with a parameter changing at random

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 15

TOPIC TAGS: mathematic model, automatic control parameter, self regulation, random process

ABSTRACT: A mathematic model of a system having many elements evolving with time is examined. The number of elements must be sufficiently large so that the system's behavior is satisfactorily described by equations with partial derivatives. Each element is characterized by a single parameter in whose space random walk is accomplished. Upon introduction of a specific interaction between elements of the system, determinate changes are observed from the time of the initial distribution according to the values of the parameter. The simplest concrete examples are considered.

357.

AUTHOR: Fomin, B. A.

ORG: none

TITLE: Problem of cortical regulation of visual perception based on data on the quantitative and qualitative characteristics of connections of the visual cortex with the lateral geniculate body

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 156-157

TOPIC TAGS: cat, visual perception, nerve fiber, visual physiology

ABSTRACT: Qualitative and quantitative characteristics of efferent and afferent connections of the cortical visual fields with ventral and dorsal nuclei of the lateral geniculate body and with the diencephalic reticular nucleus were studied. Fibers with secondary changes after destruction of cortical visual fields were investigated in long term experiment with eight cats. It was found that efferent corticos terminate in dorsal and ventral nuclei of the lateral geniculate body and also in the diencephalic reticular nucleus. Counts were made of efferent fibers from the visual region of the cortex to the dorsal and ventral nuclei of the lateral geniculate body and afferent fibers from the lateral geniculate body to the visual cortex. Comparison of the sizes of the ventral and dorsal nuclei of the lateral geniculate body demonstrated that the dorsal nucleus is 9.5 times larger than the ventral. On the basis of the quantitative characteristics obtained for the morphological structures, the volume of information which can be transmitted along the fibers of the optic tract and the above cortical and subcortical systems was determined. The lateral geniculate body obtains approximately 25 times more information along the optic tract than from the visual cortex. The quantity of information arriving from the cortex per unit of volume of the ventral nucleus of the lateral geniculate body is 7.3 times greater than information arriving from the cortex per unit of volume of the dorsal nucleus of the lateral geniculate body. This makes it possible to form a concept about the comparative participation of the indicated nuclei of the lateral geniculate body in the visual analyzer feedback system.

350.

AUTHOR: Grachev, G. I.

ORG: none

TITLE: Investigation of multichannel physiological regulators

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 35

TOPIC TAGS: biopotential, muscle stimulation, autocorrelation function, mathematic model, automatic control system

ABSTRACT: The work investigates processes of interaction of information flows of biopotentials transmitted along two axons (an exciting axon and an inhibiting one) innervating the muscle-opener of the claw of the river crab. The nerve-muscle system is also examined as an arrangement for optimal filtration which most fully considers properties of a probability multidimensional flow of biopotentials under a nonstationary surrounding environment. A method of moment autocorrelation functions which allows selecting functional space in which short term correlations are components functionally connected with movement was adopted for statistical processing of the information. Based on the results, a mathematic model of a multichannel physiological regulator is presented.

359.

AUTHOR: Gubler, Ye. V.; Pervozvanskiy, A. A.; Chelpanov, I. B.

ORG: none

TITLE: Emergency regulatory processes in a live organism as a factor of its reliability during destructive effects

SOURCE: AN SSSR. Nauchnyy sovet po kompleksnoy probleme "Kibernetika". Voprosy bioniki (Problems of bionics) Moscow, Izd-vo "Nauka", 1967, 322-326

TOPIC TAGS: automated control technology, basal metabolism, injury, automatic control theory

ABSTRACT: The work presents an analysis of the basic similarities and differences of regulatory processes during emergency situations in an organism and a technological system. Extensive burns of the skin are used as an example of an emergency situation in an organism, and the activation of the various compensatory mechanisms is described. Even with complete cessation of nerve and other cell activity, energy expenditure in an organism still continues because live tissue can exist only with continuous synthesis processes of its structural elements. Metabolism in an organism makes possible emergency regulatory measures which are not present in technological systems. Emergency regulation in technological systems generally includes the following stages:

detection of emergency (damage), notification to control center, temporary measures to insure stabilization, localization of damage effects, and operation under conditions to assure complete elimination of damage effects. Emergency regulation of technological systems is often automated: automatic indication of emergency by sound or light, signalization alerting all emergency systems, automatic transition to emergency operating conditions and automatic restoration of normal operating conditions. The high resistance of organisms to destructive effects indicates that their emergency regulation principles should be applied to technological systems. Actually, some of the functional emergency measures of organisms and technological systems do coincide partially. Though some of the principles of an organism can be applied to automation of technological systems, the main factor of self restoration which ensures the reliability of an organism cannot be realized at present because of the sharp differences in the physical chemical bases of element functioning in live and inanimate systems. From a control theory standpoint, an analysis of processes in the body during illness should be of great interest.

360.

AUTHOR: Kiforenko, S. I.

ORG: none

TITLE: Theoretical study of a system for controlling the blood sugar level.

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 63-64

TOPIC TAGS: liver, blood, sugar, gland, adrenocortical hormone

ABSTRACT: A system for regulating the glycemia level is examined which includes a process for entrance of glucose from the gastrointestinal tract into the vena porta, the homeostatic function of the liver, a process for production of insulin in the pancreas, a process for production of adrenaline in the medullary substance of the suprarenal glands, and a process for the assimilation and utilization of glucose by tissues of the organism. A theoretical investigation of the reactions of the system in response to adequate stimulation is presented. The effect of stimuli on the functional condition of organs participating in the regulation of blood sugar was studied, data characterizing the work of organs of the system under conditions of their changed sensitivity to adequate stimuli were calculated, and the results of the results of the calculation were compared with experimental physiologic data.

..361.

WHAT THE YOGIS DID NOT KNOW [CNS AUTOREGULATION]

ORG: Institute of Experimental and Clinical Medicine, Riga  
(Institut eksperimental'noy i klinicheskoy meditsiny)

Krauklis, A. Nauka i tekhnika, no. 3, 1967, 6-9.

AP7014203

The author reviews the contributions of neurophysiology and cybernetics to knowledge of the mechanisms and processes of autoregulation of the CNS, discussing the roles of excitation and inhibition, hormonal secretions, information and attention, the musculature of the body (interoceptive afferentation), and emotional states in regulating the activity level and information processing rate of the brain. He distinguishes three main types of CNS autoregulation: 1) hormonal regulation (general mobilization) activated by emotion which releases hormones transported by the blood to act on the reticular formation, which alerts the entire cerebral cortex; 2) cortical regulation (selection of information), which permits attention to be focused on high-yield information by screening out irrelevancies; and 3) muscular regulation (control of afferentation or protective reflex) which acts to avoid noxious stimuli and to prevent damage to the organism. By learning how one or more of these mechanisms of CNS regulation can be voluntarily brought into play, humans can to some extent regulate the functional state and operation of the CNS at will. [DP]

362.

AUTHOR: Kutuyev, A. B.

ORG: none

TITLE: The significance of descending connections of the cortex of the large hemispheres in self-regulation processes of the visual system

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d. Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 82

TOPIC TAGS: cat, cerebral cortex, automated control system, visual physiology, biopotential, anesthesia

ABSTRACT: Time characteristics were investigated for potentials, induced with a light flash, in the retina, the lateral geniculate body, the anterior corpus bigeminus, and in the visual cortex before and after sectioning of projective connections of the

cortex of one hemisphere. The tests were conducted on cats under conditions of acute experiments under anesthesia (nembutal 40 mg/kg). Readings were made of the unidimensional distribution functions of phase durations of induced potentials. Before sectioning the cortex, the distribution function of phase durations closely resembled the normal distribution law in which each phase of the induced potential of the given formation had a corresponding mean value. After sectioning of the projective fibers of the cortex of one hemisphere, a significant shift took place in the mean values for phases of the induced potentials of the anterior corpus bigeminum, the lateral geniculate body, and the retina on the sectioned side with preservation of the form of the distribution function. The time characteristics of the induced potentials of the visual cortex and the lateral geniculate body on the opposite side changed insignificantly. The changes established in the time characteristics of the induced potentials of the different formations indicate that the descending influences of the cortex are differentiated and constitute an important link in mechanisms for self-regulation of the visual system.

363.

AUTHOR: Kuz'minov, V. K.

ORG: none

TITLE: Mathematic models of self-regulating intra-organic systems

SOURCE: Vsesoyuznaya konferentsiya po neyrokiernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokiernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 80

TOPIC TAGS: animal, mathematic model, algorithm, automated control system, excited state

ABSTRACT: Making algorithms from data on a living system requires detection of the most characteristic manifestations of the activity of physiological elements of the system, for example, of the cells. These characteristic manifestations will contain the most reliable information about the process. It is also necessary to consider the exogenous and endogenous situations of the environment as manifestations of the stimulating effect expressed in living structures by excitation. A model of the live excitability of the system must also have self-regulating properties. The process of excitation of a biological system apparently takes place according to a law described by the equation:

$$M = N_0 \left(1 - \frac{1}{1 + e^{-k(t-t_0)}}\right),$$

i. e. during the system's response to stimulation 63% of the stimuli can be considered as search excitation, 25% as effector excitation, and 14% pertain to random connections. A very important confirmation of the homogeneity and interexchangeability of separate elements of the excited biological system, which determines the survival (stability) of the system as a whole, is included in the equation:

$$\frac{dN}{dt} = -\alpha N$$

The mathematical proofs of this conclusion are contained in the exponential function and in view of their elementary nature are not presented. The concept of the threshold density of excited elements makes it possible to describe the quantitative course of the excitation process.

364.

AUTHOR: Lishchuk, V. A. Patskina, S. A.; Lissova, O. I.

ORG: none

TITLE: The self-regulation system of the heart

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 83-84

TOPIC TAGS: heart, automatic control system, mathematic model

ABSTRACT: Stabilization of the functional condition of the isolated heart and investigation of its reactions within specific limits of arterial and venous loads are necessary conditions for deterministic behavior. Single-valued repeating statistical characteristics (venous and arterial) of the heart, approximating linear and exponential analytic expressions, were obtained from experimental data observing these conditions. Experimental investigation of self-regulation of the heart demonstrated that arterial pressure is an independent regulator of the heart's output. The constancy of a minute volume within broad limits of change in the average arterial pressure is a feature of this aspect of the heart. A mathematic model of the heart relative to its basic function was constructed on the basis of experimental and literature data and reduced to a form typical of combined pulse-continuous automatic control systems. Comparative investigations of the model and the object demonstrated good adequacy within limits of the range of determination.

305.

AUTHOR: Malyutova, Zh. K. Motsnyy, P. Ye.; Shugurov, O. L.

ORG: none

TITLE: Investigation of the regulator properties of the neuromuscular transmission mechanism

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 90-91

TOPIC TAGS: cat, neuron, muscle stimulation, tracking control, signal transmission, mathematic model

ABSTRACT: The transmission of signals in a neuromuscular apparatus with single and rhythmic stimulations of the motor nerve was investigated in experiments on a neuromuscular preparation from cats. The important role of tracking processes taking place in the region of myoneural synapses in regulation of the amplitude of subsequent signals was demonstrated. Each signal leaves behind it a track which can be considered as an expression of the short term dynamic memory of the system. The law of forgetting (disappearance of the track) is close to an exponential one. The experiments demonstrated the possibility of superimposing tracking processes with specific frequencies and establishing a specific level of amplitude of responses to a rhythmic series of stimulations. Study of changes in biopotentials of the anterior tibial muscle and of the gastrocnemius muscle (range of frequencies 2-150 cps) led to the simplest mathematic model taking into account the most general properties of the myoneural synapse. Analysis of the model on a computer confirms the correctness of concepts of methods for regulating signals in the region of their transmission from nerve to muscle. The experimental data was confirmed by calculations of an equation describing the process of response reaction stabilization, using a number of frequencies and different values of coefficients.

366.

AUTHOR: Pavlenko, V. M.

ORG: none

TITLE: Hypothetical action mechanism of a constant magnetic field on biologic systems

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 110

TOPIC TAGS: electromagnetic biologic effect, protein synthesis, bioelectric phenomenon, ribonucleic acid, DNA, genetics, constant magnetic field, biosynthesis

ABSTRACT: Nucleic acids in the cell regulate protein synthesis and the transmission of genetic information. According to modern theory the process of synthesis is a closed self-regulating loop based on the feedback principle. Its basic links are the synthesis of m-RNA on informationally homologous DNA, the synthesis of protein on m-RNA, and metabolic transformation and repression of synthesis of m-RNA on the DNA metabolite. The author hypothesizes an action mechanism of a constant magnetic field on living systems which comprises three moments acting in a set on complex dynamic variable cells: 1) a mechanical-chemical moment which includes interruption of regulation of biosynthesis caused by change in orientation of the macromolecules.

Change in orientation disturbs delivery of the molecules, in particular of L-RNA, in the peripheral loci of the cell, which leads to disturbance in the kinetics of biochemical reactions; 2) a structural-chemical moment which includes change in the conformation of the macromolecules; and, 3) a magnetic-electric moment characterized by change in the path of ions of the cellular electrolytes as a result of the effect of the magnetic field.

367.

AUTHOR: Rastrigin, L. A.

ORG: none

TITLE: "Emergency" control in a biological system [transformation of a cell into a cancerous cell as an example]

SOURCE: AN SSSR. Nauchnyy sovet po kompleksnoy probleme "Kibernetika". Voprosy bioniki (Problems of bionics) Moscow, Izd-vo "Nauka", 1967, 326-328

TOPIC TAGS: cell physiology, carcinoma, homeostasis, DNA

ABSTRACT: The paper describes the emergency control mechanisms of a living system represented, in this case, by a cell when emergency conditions are induced by a carcinogen acting on the cell. A hypothesis is advanced that a living system has a homeostatic type mechanism which when activated tries to find by random search of possible states a new stable state and then is inactivated. Thus, random search represents the reaction of a living system to emergency conditions. The cell can be considered a chemical machine converting substances into other substances. The units of this machine are microreactors in which one substance under the influence of another substance is converted into a third substance. The structure of such a network is coded genetically in the DNA where the preparation formulas for all substances which can be produced by the cell are found. Under normal operating conditions only a small number of microreactors is activated in the cell; and, the other microreactors are inactive although at any given moment they are potentially ready to produce any of the substances as soon as the corresponding enzymes appear at their inputs. Cell functions are a result of the appearance of certain forms of enzymes synthesized by the cell. All cell functions can be divided into general and specialized functions. The loss of any of the general functions by the cell endangers the cell's life, but the loss of any of the specialized functions threatens the organism and not the cell. A carcinogen, a complex active substance, acting on many units at the same time inactivates some of the active units and activates some of the passive ones. Then a transitional process starts in the network which is characterized by further transition of the units from active to passive ones and vice versa. Thus, new substances are produced and substances normally produced are no longer formed. This transitional state will stop only when a stable state is found. If the transitional process has affected only a small part of the network, then the cell functions may be completely preserved. But, if a large part of the cell is affected, the least protected functions will be lost. When a carcinogen acts on a cell of an organism, the cell in turn reacts by a random search for a new stable state. Depending on the carcinogen composition and cellular network structure, the cell can preserve all its functions or can lose its functional connection with the organism; in the latter case, the cell degenerates into a cancerous cell and can lead to death if vital functions are lost. Emergency conditions in an organism are avoided to a considerable extent due to mechanisms of a homeostatic type which do not require preprogramming.

368.

AUTHOR: Safonov, V. A.

CRG: none

TITLE: Respiratory regulation under conditions of excess intrapulmonary pressure

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 134

TOPIC TAGS: animal, neuron, respiratory system, biopotential, nerve, drug effect, brain

ABSTRACT: Recordings were made in animals of electric activity in the nerve trunk connecting lung receptors with the respiratory center (the vagus nerve) and the respiratory center with the respiratory motor apparatus (the diaphragmatic nerve) and also of the electric activity of the internal intercostal muscle and the straight muscle of the abdomen. The inflow of afferent impulses was limited by cutting the vagus nerve or creating external counterpressure on the animal body or affecting the condition of respiratory center neurons directly by administration of chlorpromazine, nembutal, or adrenaline. A profound rearrangement of intracontral relationships in the medulla oblongata respiratory center occurs during and after excess intrapulmonary pressure. Apparently change in the interrelations of the functioning neurons and involvement in the activity of a considerable number of new neurons both occur under the effect of significantly changed conditions for performance of respiratory movements in the respiratory center.

369.

AUTHOR: Sarafyan, N. Ye.

ORG: Neurobiology Laboratory AN ArmSSR (Laboratoriya neirobiologii AN ArmSSR)

TITLE: One problem concerning multilevel regulating systems

SOURCE: Biologicheskiy zhurnal Armenii, v. 20, no. 6, 1957, 44-48

TOPIC TAGS: mathematic model, brain, adaptive control, optimal control

ABSTRACT: A simplified mathematical model is offered for the behavior of a higher living organism which reacts to changes in the environment in the most biologically advantageous way. The control system consists of several levels. The reaction of the lowest level of the brain (medulla) is corrected by the next higher level (cerebellum), etc. The final refinement is achieved at the highest level (cortex), where the reactions of the lower levels are controlled and integrated. The corresponding model is assumed to consist of  $n$  levels, the lowest of which has only one variable  $x_1$  (e. g., the total number of excited neurons in a given nerve center), whose values have an upper limit. A gauging function of the next level depends on two variables, and the gauging function  $\varphi_n(x_1, x_2, \dots, x_n)$  of the  $n$ th level depends on  $n$  variables, the sum of which has an upper limit. The expression

$$\sum_{i=1}^n \varphi_i(x_1, x_2, \dots, x_i), \quad (2)$$

must be optimized. This is done by dynamic programming methods in which the gauging function of the highest level is optimized first, and then the lower functions are optimized in succession. A recurrent formula is given connecting the successive steps. The optimization can also start with the lowest level; both processes are mathematically equivalent. The question as to what direction is actually realized in the living organism may be of theoretical and practical interest. Orig. art. has 14 equations.

370.

AUTHOR: Vasilik, P. V.

ORG: none

TITLE: Simulation of neural mechanisms for regulation of heart activity

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 21

TOPIC TAGS: heart, biologic model, self regulation/ (u) MN analog computer

ABSTRACT: The model for controlling heart activity based on physiological concepts of the control mechanisms of this organ is proposed. The model, on a MN-7 analog computer, reflects sympathetic and parasympathetic means of control, and feedbacks with interoceptors. The case of short term change in load when the neural mechanisms basically control change of heart activity is examined. It is assumed that other (hormonal) control mechanisms are not fast enough to react effectively in a short time period. Data from experiments on the model are compared with data from experiments with people to determine sensitivity changes of heart mechanisms in respect to controlling influences in ontogenesis.

371.

AUTHOR: Volynskiy, A. M.

ORG: none

TITLE: Phylogenetic improvement of the self-regulating system of the motor act

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-On-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 25-26

TOPIC TAGS: pigeon, frog, sensory motor area, proprioception, muscle stimulation, visual perception

ABSTRACT: The motor act self-regulating system for prolonged or brief maintenance of a specific position of the body of an animal or human in space was investigated. An electron oscillograph with an amplifying system was used to record discharges of proprioceptive impulses from the extensors and flexors of the pigeon wing and the hind foot of the frog, and the effector stimulation of muscles of the central nervous system during limited flight of the bird and jump of the frog. Similar experiments were conducted under artificial closing of eyes. Discharges of proprioceptive impulsion in pigeons are almost two-fold in quantity and frequency over those in frogs. The effector output of impulse flows to the muscles in pigeons in 40-60%

higher than in frogs. Artificial closing of eyes had little effect on proprioafferentation of frogs but had a clear effect on pigeons. Results show that, in birds, information reaching the brain from the visual analyzer is important for improvement of the motor act self-regulating system.

372.

AUTHORS: Zakharov, V. K.; Il'yutkin, G. N.; Lypar', Yu. I.; Maystrakh, Ye. V.

ORG: none

TITLE: Restoration and maintenance of homeostasis in terminal states under conditions of interaction of an automaton and an organism

SOURCE: AN SSSR. Nauchnyy sovet po kompleksnoy probleme "Kibernetika". Voprosy bioniki (Problems of bionics) Moscow, Izd-vo "Nauka", 1967, 311-315

TOPIC TAGS: bionics, cybernetics, automatic machine, automaton, homeostasis, dog, blood pressure, biologic respiration, heart, digital computer, data storage, data analysis

ABSTRACT: An automatic digital analyzer and regulator of physiological functions is described. It automatically normalizes vital functions in the presence of severe disturbances due to blood loss, introduction of a peptone solution, and an ether overdose. Arterial pressure, heart activity, respiration, and bioelectric activity of the brain were used to determine the state of the organism. The device measures the extrema and duration of nonperiodic electric oscillations in four channels simultaneously, averages the results over a given time interval, and stores the averaged data with subsequent logic analysis for actuation of the necessary control elements. The device uses about 1500 ferrite-transistor and ferrite-diode components. In 138 tests of 38 dogs, only nine died, of which seven died when the test was repeated on them. Orig. art. has: 2 tables and 2 figures.

SECTION H. ARTIFICIAL INTELLIGENCE (PATTERN RECOGNITION, LEARNING PROGRAMS, SPECIAL DEVICES)

373.

AUTHOR: Amosov, N. M.; Kasatkin, A. M.; Kasatkina, L. M.

O:G: none

TITLE: Possibility of creating an artificial intellect based on M-networks

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 5-6

TOPIC TAGS: algorithm, neuron, artificial intelligence

ABSTRACT: The report describes the basic theses of heuristic simulating of psychic functions with networks of elements similar to neurons. A discrete-analog information model of the neuron is proposed, and static and dynamic characteristics of the model are presented. The neuron network is examined and some of its properties are investigated. The formation of neuron networks from ensembles of neurons is described. They are examined as information models--i-models (structural representations in the network) of codes of input effects. Results are presented of an experimental investigation of a digital computer program simulating the formation of i-models, and the properties of the i-models are considered. Networks whose elements are i-models of the M-network are examined, and the principles of semantic organization of the M-networks are stated. The possibilities of simulating basic psychic programs with M-networks are analyzed. A functional algorithm is described and the information processing role of the M-network in a hypothetical amplification-breaking system is discussed. Definitions of complete and incomplete M-automata are given, and examples of M-automata are presented.

374.

AUTHOR: Inozemtsev, A. N.; Novikov, P. P.

ORG: none

TITLE: Investigation of learning algorithms in elementary environments

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 56

TOPIC TAGS: learning process, algorithm, environment simulation, probability

ABSTRACT: Any complex tactics for solving information problems are based on the presence in the environment of a specific complex of limitations. A study was made of search tactics with limitations in elementary environments; these have certain important advantages over complex environments for investigating a given question. Elementary environments have two states,  $a_{init}$  and  $a_{fin}$ , between which an objective connection exists, i.e. there is a certain operator  $\beta$  from  $B = (\beta_1, \beta_2, \dots, \beta_m)$  which translates the environment from one state to another. The state of the environment is a word in a certain alphabet  $A = (a_1, a_2, \dots, a_n)$ . The environments selected for examination were determined environments, environments of probability upon transition, those of probability in the initial and final states, environments with noise, and others. Results of experiments and simulation of behavior in these environments are presented.

375.

AUTHOR: Kravchenko, A. I.

ORG: none

TITLE: Structure of self-learning recognition systems

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 73-74

TOPIC TAGS: learning process, form recognition, mathematic model, algorithm, probability

ABSTRACT: A general structure for self-learning recognition systems assumes the following: a) the object of recognition is the abstract logical form  $B_j E(B_j)$ , which requires distinguishing  $B_j$  from other elements of the set according to available characteristics  $A_j E(A_j)$ ; b) the nature of a recognizable form is determined without utilization of information according to which it is recognized; c) semiotics are limited only by the rules for determination of characteristics in the case of continual recognizable information; and d) the "characteristic-phenomenon" cause and effect relation is a stochastic one with evaluation of the recognizable significance of a characteristic of a statistical conditional probability  $p(B_j/A_j)$ . An open model

having unlimited expansion of compared denumerable sets of characteristics and phenomena in the self-learning process is examined. Semi-open models with expansion according to  $m$  or  $n$  and closed-loop models with  $m$  and  $n$  fixed are special cases. The material for model construction is reliable information about reliable phenomena (about the realization of  $A_i/B_j$ ). The logical basis of the model is the matrix  $(p_{ij})_{m,n}$  with the elements  $(B_j/A_i)$ . Simple self-learning is attained by adding a basic recognition program (a known one is assumed); a) with a program of change in the principle matrix according to a reliable result of each solution; and, b) with a subprogram of exclusion from the solution of parts (lines) of the principle matrix which are constructed on statistically insufficient material. The possibility is demonstrated of self-improvement of self-learning recognition systems by addition of an algorithm: a) with searches for the complex of K-characteristics of combinations of simplexes of C-characteristics, including negative ones yielding more exact solution than solution according to the set of individual C-characteristics; b) inclusion of effective K-characteristics in the logical basis of the model; c) discovery of K-characteristics in a set given for solution and the sets of C-characteristics substituted in it; and, d) expansion of the model according to  $n$  by the addition of the set  $B$  of elements  $B_j$  and others.

376.

INVENTOR: Kreynin, S. I.; Lashevskiy, R. A.; Maksimov, M. N.; Rabkina, N. V.; Khavkin, V. Ye.; Skvortsov, A. M.; Norkin, L. M.

ORG: none

TITLE: Memory device. Class 21, No. 184935

SOURCE: Izobreteniya, promyshlennyye obraztsy, tovarnyye znaki, no. 16, 1966, 55

TOPIC TAGS: computer memory, computer storage device

ABSTRACT: This Author Certificate introduces a word-organized memory consisting of multiaperture ferrite plates, and a magnetic decoder with transformers using multiaperture ferrite plates (see Fig. 1). To increase both the speed and capacity

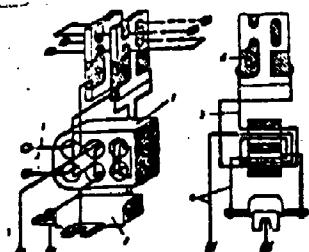


Fig. 1. Memory device

1 - Ferrite plate; 2 - diode matrix;  
3 - bias winding; 4 - excitation winding;  
5 - output winding; 6 - printed winding.

and to reduce the required power, the magnetic decoder contains a diode matrix of integral planar structures with a number of p-n junctions equal to the number of addresses in the device. Orig. art. has: 1 figure. [JR]

377.

SYNTAX AND ELECTRONICS

Leninskaya smena, no. 45, 4 Mar 67, p. 4, col. 5.

AN7009181

At the Institute of Languages of the Ukrainian Academy of Sciences, A. Grishchenko selected various literature texts which were then recorded on a tape recorder. The texts were electronically analyzed and the intonations determined in the form of physical quantities.

[NC]

378.

AUTHOR: Nikolau, E.; Popovich, A.

CAG: none

TITLE: A question on the theory of form recognition systems

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 104

TOPIC TAGS: pattern recognition, experimental psychology

ABSTRACT: A general theory for form recognition and principles for realization of some devices which identify acoustic and graphic forms are described. The theory makes use of abstract, multidimensional space, and an area of general space corresponds to each recognizable form. Categories of forms recognized unambiguously and ambiguously were determined. A specific multidimensional vector was given to each form, and a specific form was recognized by calculating the product of the vector applied to it and vectors from a reference set. The recognized form, by being classified in the category of forms represented by the vector with its product  $r \times r_{oi}$ , is equal to zero. Recognition of acoustic forms involves a theory of signals of vowels and a simple device based on spectral theory for identifying vowels.

370.

AUTHOR: Sarkisov, S. A.; Strigin, Yu. S.; Lyubinov, N. N.

ORG: none

TITLE: Learning by networks of threshold elements

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 133-134

TOPIC TAGS: neuron, learning process, mathematic model

ABSTRACT: Learning of behavior in a dynamic environment is understood as the minimization of mathematic expectation  $M[Q(x, \Lambda, \tau, h)]$ , where  $x$  is the input vector-function for the segment  $(C, T)$ , and  $\Lambda(\tau, h)$  are the sets of all synaptic weights, delays and network element thresholds.  $Q$  is a quality function which is usually an unknown and is given in the process of work on individual pairs  $(x, y)$ , where  $y$  is the output vector function of the network which is single-valuedly determined by input  $x$  and by  $\tau$  and  $h$ , the parameters of network  $\Lambda$ . The networks of threshold elements are divided naturally into layers. If all layers have the same number of elements then a semigroup is formed, generated by all threshold transformations (the layer of threshold elements corresponds to the element forming the semigroup). The semigroup becomes finite in the case when the network is without synaptic delays and is infinite when the network has delays. Different algebraic and combinatorial problems arise in connection with clarification of the structure of the semigroup. Strict inclusion of the constructed semigroup into the semigroup of all transformations (the incompleteness of the semigroup) was proven. It was demonstrated that the semigroup contains all transformations for all possible divisions of the aggregate of input vectors into two forms, and the length of the corresponding layer in the semigroup (the quantity of layers) does not asymptotically exceed  $2^n$ . Using some specific examples of learning, it is demonstrated that these problems are related to others not directly pertaining to neuron networks.

Best Available Copy

AUTHORS: Semenova, Yu. I.; Vetel'baum, I. M.

C.G: none

TITLE: Criteria for the discrimination of a limited set of words

SOURCE: AN SSSR. Nauchnyy sovet po kompleksnoy probleme "Kibernetika". Voprosy bioniki (Problems of bionics) Moscow, Izd-vo "Nauka", 1967, 68-75

TOPIC INDEX: compressed word codeforming, speech recognition, coding evaluation, communication coding, coding

ABSTRACT: Criteria for coding words into an unambiguous binary quantity are discussed, and the efficiency of a coding system is analyzed for word lists. The words are coded on the criteria of: number of syllables; the accented syllable; the number of tip-of-the-tongue teeth sounds; number of breath-explosive consonants; etc. With an  $m$ -digit binary code there are  $A = 2^m$  distinct code values available. If a one-to-one correspondence between  $n$  words ( $n < N$ ) and a code value ( $a < A$ ) can be established with a list of  $N$  words, we have an unambiguous coding of part of the words using part of the  $N$ . For an ideal coding,  $n = N$ ,  $a = A$ . Four lists of words have been studied: 10-word list of digits to a 600-word list of computer terms. Ten criteria were used into a 16-digit binary code ( $m = 16$ ). The codability coefficient ( $k_A$ ) was calculated as the ratio of the entropy of the coded words  $H(n)$  to the entropy of the entire list  $H(N)$ . For equally probable and mutually independent words  $k_N = \log n / \log N$ . Similarly, the coefficient of code usability ( $k_A$ ) is  $H(a)/H(A)$ . The coding effectiveness coefficient ( $k_e$ ) then is  $k_e = k_N k_A$ . The effects of unequal word probability and interdependence are considered. For the 10-digit list  $k_N = 1.00$ ,  $k_A = 0.207$ ,  $k_e = 0.207$ , and for the 600-word list  $k_N = 0.978$ ,  $k_A = 0.562$ ,  $k_e = 0.550$ . By using only seven digits,  $k_e$  for the 10-word list increased to 0.403. The circuit for accomplishing the coding is presented and the details of operation of the circuit for counting the number of tip-of-the-tongue teeth sounds are discussed. Orig. art. has: 3 tables, 6 figures, and 7 formulas.

381.

INVENTOR: Sokolov, S. N.

ORG: none

TITLE: Optical memory unit. Class 21, No. 185367

SOURCE: Izobreteniya, promyshlennyye obraztsy, tovarnyye znaki, no. 17, 1966, 29

TOPIC TAGS: computer memory, laser optics

ABSTRACT: This Author Certificate introduces an optical memory unit consisting of controlled light sources, a write information register, a photodisk, and light sensors (see Fig. 1). The coherent monochromatic light sources are placed in front

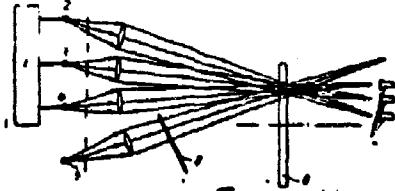


Fig. 1. Optical memory

1 - Register; 2, 3, 4 - coherent monochromatic light sources; 5 - reference source; 6 - photodisk; 7 - photo-sensors; 8 - etched glass.

of the photodisk and are coupled to the register containing the information to be stored. The coherent reference source is placed in front of an etched glass while the light sensors are located at the focal points of the system behind the photodisk. The advantages of this memory are its reliability and the increased write information density permitted by superimposing the stored information. Orig. art. has: 1 figure. [BD]

382.

AUTHOR: Torgovitskiy, I. Sh.

ORG: none

TITLE: Pattern recognition in the absence of a learning process

SOURCE: AN SSSR. Nauchnyy sovet po kompleksnoy probleme "Kibernetika". Voprosy bioniki (Problems of bionics) Moscow, Izd-vo "Nauka", 1967, 107-113

TOPIC TAGS: bionics, cybernetics, pattern recognition, algorithm, integral equation, polynomial, error, function, probability, probability distribution, minimization

ABSTRACT: Methods of pattern recognition in the absence of learning are examined. Information on the input situations enters the recognizer in the form of an n-dimensional vector of the criteria  $X = (X_1, X_2, \dots, X_n)$  so that any situation corresponds to a point in an n-dimensional space. A situation is related to one of the classes according to the sign of the decision function  $\gamma = L(X) - H$ , where

$$L(X) = \frac{P_2(X)q_2}{P_1(X)q_1}$$

is the likelihood ratio;  $H$  is a threshold in whose selection the costs of errors can be taken into account; and  $P_1(X)$  and  $P_2(X)$  are the conditional probability density functions for the appearance of point  $X$  in a corresponding class. Given the equation

of a hyperplane

$$y = a_0 + \sum_{i=1}^n a_i X_i,$$

it is shown that, when  $P_1(X)$  and  $P_2(X)$  are unknown, it is possible to determine the unknown coefficients that ensure the best division of the criterion space into two classes. The function

$$F = q_1 \sum_{i=1}^n (d_i^{(0)})^2 + q_2 \sum_{i=1}^n (d_i^{(1)})^2,$$

where

$$d_i = \frac{a_0 + \sum_{i=1}^n a_i X_i}{\sqrt{\sum_{i=1}^n a_i^2}}$$

is minimized by extrapolation. Stochastic approximation gives the recurrent algorithm

$$a_i^{m+1} = a_i^m + \delta^m |(a^m, X^{m+1})| X_i^{m+1},$$

$$i = 0, n; X_0 = 1,$$

where  $a_i^{m+1}$  is the i-th coefficient of the dividing hyperplane in the  $(m+1) - M$  step,

and

$$\delta^m = \begin{cases} 0, & \text{if } (a^m, X^{m+1}) > 0 \text{ and } X^{m+1} \in I \\ 0, & \text{if } (a^m, X^{m+1}) < 0 \text{ and } X^{m+1} \in II \\ 1, & \text{if } (a^m, X^{m+1}) < 0 \text{ and } X^{m+1} \in I \\ -1, & \text{if } (a^m, X^{m+1}) > 0 \text{ and } X^{m+1} \in II \end{cases}$$

Other methods are discussed. Orig. art. has: 6 formulas.

383.

AUTHOR: Vaynikko, G. M.; Petunin, Yu. I.

ORG: none

TITLE: A learning program for solution of optimal problems

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-On-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 18

TOPIC TAGS: learning program, function, perceptron, optimal automatic control

ABSTRACT: A method of local search for the extreme of a function from a certain class of single-type functions for a learning program is examined. The basic feature of the method is an improvement in the convergence rate in relation to learning. The learning process can take place analogously to the method for correcting errors with quantification of elementary  $\times$ -perceptrons. A hypothesis is advanced that this principle of local search lies at the basis of optimization processes taking place in the animal with the development of motor skills.

**SECTION I. MISCELLANEOUS ITEMS RELATED TO BIONIC AND BIOCYBERNETIC STUDIES**

384.

AUTHOR: Belkin, V. G.

ORG: none

TITLE: Use of transposing devices for obtaining an EEG correlation function

SOURCE: Vsesoyuznaya konferentsiya po neyrokiernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokiernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 11

TOPIC TAGS: correlation function, magnetic recording

ABSTRACT: EEG correlation analysis in the range of subsonic frequencies increases the volume of useful information obtained by researchers. Existing types of correlators using magnetic recording do not always satisfy requirements for necessary analysis time, accuracy of analysis and other parameters. The report examines problems related to the use of transposing devices, based on magnetic recording, for obtaining correlation characteristics of an EEG. A block diagram of a spectrum transformer is presented, possible operating conditions are examined, and some correlations are calculated for given basic parameters.

385.

AUTHOR: Genes, V. S.; Lokshina, V. A.

ORG: none

TITLE: Investigation of the stability of some EEG parameters

SOURCE: Vsesoyuznaya konferentsiya po neyrokiernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokiernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 30

TOPIC TAGS: rabbit, EEG, automatic control parameter

ABSTRACT: The statistical characteristics (first to fourth moments, asymmetry, excesses in errors, statistical connections) of the following parameters were investigated: 1) amplitude distributions; 2) EEG autocorrelation functions; 3)

spectral density functions; 4) distribution of EEG waves by frequency and amplitude according to Faure; 5) parameters according to Gnekin: a) average asymmetry of EEG waves; b) correlation coefficient for ascending and descending phases; c) correlation coefficients for descending phases and the ascending phases following them; d) autocorrelation functions of time series, consisting of the lengths of periods, asymmetries, and ascending and descending phases; e) distribution of ascending and descending phases expressed in discrete units with an estimate of the deviation from the theoretical distribution according to the  $\lambda^2$  method; and 6) characteristics of the interrelationship of the ascending and descending phases expressed in discrete units. EEG in the form of ink recordings were fed into the Ural-2 electronic computer with a device developed at the Khar'kov Branch of the Institute of Mechanics AN UkrSSR. Experiments were conducted on rabbits with electrodes implanted in bone for the visual and motor zones of the cortex. The biological currents of the visual cortex were studied under conditions of darkness and rhythmic photostimulation of different frequencies.

### 386.

#### PROBLEMS OF COMPLEX SYSTEMS

Gnedenko, B., L. Dudkin, and B. Korobochkin. *Ekonomicheskaya gazeta*, no. 48, Nov 67, p. 28, col. 1-4. AN7033944

In October 1967 the All-Union "Znaniye" Society held a conference on the scientific and practical problems of complex systems. About 800 scientists representing over 200 organizations from Moscow and other cities participated. Approximately 100 papers were presented, including reports by 9 academicians and 13 doctors of sciences and professors.

The problem of establishing automated planning and control systems by applying computer technology to economic and mathematical methods was discussed and it was stressed that attempts to apply such technical means to existing work procedures require that the forms and methods themselves be changed. The main problem is that those developing such systems do not have the necessary training in economics and mathematics and are not acquainted with the basic principles of the systems approach. Those establishing branch systems are urged to concentrate less on the technical means of selecting, sorting, and collating information, and more on the development of new scientific methods.

It has often been demonstrated that man only uses an infinitesimal part of available information in making decisions and usually only qualitatively, i.e., he does not subject information to quantitative processing. Thus, the value of information systems that simply increase the amount of information reaching the user is questioned, since they do not result in the most profitable use of electronic computer technology. Another serious defect of information processing systems is that they fossilize inadequate forms of planning and administration. The system must become

an adjunct of man, and must "think" not instead of him but for him. Using the systems approach it is possible to reduce the process of complex problem solution to the reciprocally related process of solving less complex problems, but in greater detail. This approach requires the construction and use of a complex of economic and mathematical models in order to find the best solutions.

The conference concluded that the failure to meet the requirements of the systems approach when establishing automated systems has resulted in a failure to meet objectives. The conference also discussed methods of investigating the behavior of man in man-machine systems and other special problems of the construction of complex sets consisting of qualitatively heterogeneous elements. The conference recommended the creation in all basic branches of the national economy of design and scientific research institutes for automated systems of planning and control and urged that they be staffed with qualified scientific-technical and economic-mathematical administrators. [NC]

300

## SECOND ALL-UNION CONFERENCE ON BIONICS (USSR)

ORG: none

The Second All-Union Conference on Bionics, organized by the Academy of Sciences USSR, the Ministry of Higher and Secondary Specialized Education, the Academy of Medical Sciences USSR, and the All-Union Scientific-Technical Society for Radio Engineering and Telecommunication imer. A. S. Popov, held at Moscow State University from 20 to 24 December 1965, was attended by some 1000 scientists and engineers from the USSR, Bulgaria, and Hungary. Among the participants were 600 radio, electrical, mechanical, and automation engineers and specialists in computer technology and cybernetics; 180 biologists, physiologists, and physicians; and 180 physicists, mathematicians, psychologists, chemists, philosophers, and other specialists. Six papers were presented in the plenary sessions and 100 in the various sections.

Academician A. I. Berg and Prof. B. S. Sotskov presented a paper entitled "Present status and trends in the development of bionics" dedicated to general problems of bionics. It is pointed out that the most important results and studies in bionics in the last few years were associated with the processes of receiving and processing information. These include studies concerned with the design of quick-response, reliable, small, and economical elements on the basis of the performance of receptors and analyzers in animals (ear, eye, olfactory organs, and others); with the structure of orientation and navigation systems in animals; and, on the basis of these studies, with the design of response devices and new navigation and communication systems. A great deal of attention has been paid to developing information-transforming devices and systems, to evaluating and storing information, to constructing neuron and neural net models, to searching for new methods for solving complex problems, in particular, to developing heuristic programming methods and to developing bionics aspects in pattern recognition problems. The opinion is expressed that important results can be expected in designing high-quality amplifying, relay, and logic elements and devices which ensure the separation of signals from noise and also in searching for new methods and physical principles for time-dependent and spatial selection of signals. A series of bionics problems were indicated which the authors considered urgent.

N. P. Naumov, S. N. Simkin, V. D. Il'ichev, and V. R. Protasov presented a paper entitled "Means of communication in animals and their modeling" in which the problem of controlling the behavior of a large number of wild animals on the basis of modeling the signals (chemical, optical, acoustic) serving as means of communication between the animals is analyzed.

In a paper entitled "The problem of modeling a universal sensor," Yu. A. Vinnikov analyzed the receptor cells of various sensing organs from a single point of view.

In the paper by L. P. Krayzmer entitled "Modern concepts of the human memory and bionic means for designing the memories of cybernetic machines," the peculiarities of the human memory are analyzed, and its capacity, specific capacity, and efficiency as compared with computer memories are evaluated. The course of further studies of the memories of biological systems is outlined.

The paper by S. Ye. Kleinenberg and N. V. Kokshayskiy entitled "Modern problems in biological aero- and hydrodynamics," presented at the closing plenary session, analyzes the problem of modeling the adapting process of flying or swimming animals, ensuring high velocities at low loss of energy. A critical analysis of attempts to explain why the hydrodynamic resistance of swimming animals is low is presented.

In the last paper presented at the plenary session by K. N. Karandeyev, A. I. Puchkin, M. Ya. Subbotin, and Ya. D. Finkinshteyn, entitled "Certain general regularities in chemical reception illustrated by means of the example of an odor perception mechanism," a series of general principles in the structure of neural mechanisms which execute the task of chemical reception are presented.

The other hundred papers were presented in five sections: 1) receptors, analyzers and pattern recognition; 2) neural organization and bionic aspects in reliability; 3) bionic aspects in control, regulation, and in the man-automation problem; 4) orientation and navigation in animals; 5) biomechanics and bioenergetics. The chairmen of these sessions were: Corresponding Member of the Academy of Sciences USSR G. V. Nikol'skiy; and Professors N. P. Naumov, S. N. Braynes, L. P. Krayzmer, A. B. Kogan, A. V. Netushil, V. V. Chavchanidze, S. F. Manziya, Ya. A. Vinnikov, and L. O. Belopol'skiy. The many problems analyzed in the sections included the organization of structures which realize pattern recognition processes, algorithmization of these processes, the connections between learning and pattern recognition, and the design of devices simulating the various stages of the recognition process. A series of papers were dedicated to the synthesis of formal neurons, the relation between the reliability of the brain and its probabilistic-statistical organization, modeling the axodendritic sphere of a neuron, and the design of memory devices on the basis of biological systems. A great deal of attention was paid to papers concerning the effects of electromagnetic phenomena on biological memory systems in man and on machine memories, the motor processes and the mechanisms for controlling them, and behavior and search mechanisms. The problems of orientation and navigation in insects, fish, and birds and of constructing of models on the basis of data obtained from studying the motor organs of animals were analyzed.

[LK]

The Conference recommended that specialists be trained in bionics and that postgraduate studies be organized in bionics at the universities, institutes of the Academy of Sciences USSR, and other scientific institutions.

SOURCE: Kazmin, G. I. The Second All-Union Conference on Bionics. Avtomatika i telemekhanika, no. 5, 1966, 204-206.

TOPIC TAGS: bionics, All Union Conference, biological process modeling

388.

AUTHOR: Rezhabek, B. G.

ORG: none

TITLE: Probability organization on the molecular and cellular levels

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d. Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967; 129

TOPIC TAGS: cell physiology, probability, molecular structure, enzyme, DNA

ABSTRACT: The probability organization of processes inside the cell should not be considered as the direct consequence of principles of quantum mechanics or statistical physics. Principles of the former are for basic construction of the molecules, and those of the latter lead the system to disorganization or stable equilibrium. Probability organization on the molecular level should be understood as the absence of a rigid, unchanged structure of the molecule or the molecular complex and as appearance of this structure at the necessary moment with a specific degree of probability. Specific examples are presented of such structures, which include: a) the organization of an active center of enzymes (according to Koshland); b) the kinetics of reduplication of DNA (according to Volkstein); c) the functioning of the system of cistrons (according to Jacob); and, d) the probability organization of the receptor membrane.

389.

AUTHOR: Terekhov, V. A.

ORG: none

TITLE: The "game tree" and human search for problem solutions

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 146-147

TOPIC TAGS: game theory, thought process, computer simulation

ABSTRACT: The process of solving a game problem by machine or by man can be represented in the form of a "game tree." Analysis of experimental materials demonstrated that while a "game tree" is the summary characteristic of the total work performed by the subject, it does not reflect the organization of search itself (the sequence of individual searching acts). The "game tree" establishes the sequence of moves, but does not completely express the preparation of this sequence. At best the "game tree" fixes the interactions examined by the subject which have a character of direct moves, and does not reflect a meaningful relation between individual attempts at problem solution. The "game tree" also expresses certain more approximate characteristics of searching activity. The "game tree" does not include what the subject has not examined, but does reflect qualitative differences between individual stages of the problem solving process. Correlation between actual search by man for problem solutions and the plan of the "game tree" should be taken into account in computer simulation of the human problem solving process.

390.

AUTHOR: Tsepkov, G. V.

ORG: none

TITLE: Problems in designing systems for collection and processing of neurophysiological data

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); reforaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 158-159

TOPIC TAGS: information processing, neurophysiology, data processing equipment, electronic equipment

ABSTRACT: Principles for the design of complex electronic systems for collection, transformation, and processing of biological information were examined. Instruments and devices which are part of these systems must ensure organization of an experiment according to a prescribed program under automatic control. Moments of switching produced by a device can be functions of time or can depend on the reaction of the investigated object. Problems connected with ensuring coordinated work of the equipment used in experiments can be solved by using a multichannel generator with stepped frequency regulation as a synchronizing device. In so doing the pulsation frequency at the output of each generator channel must always be a multiple of the frequency of the stabilized source of oscillations. The system must provide multichannel reading and recording of the potentials, as well as visual and auditory indication, and general purpose amplifiers with a large coefficient of amplification can be used for this purpose. The problem of a general purpose stimulator is solved by special devices which are active lines for pulse delay for controlling the work of standard generators. The parameters of the generators' stimuli partially respond to the requirements of the procedure. Transformations of impulse activity into a continuous signal (for processing on an electronic computer) and the inverse transformation (for processing on a digital computer) must be provided in the system. Use of specialized computers for analysis of experimental data is advisable in a number of cases.

391.

AUTHOR: Zakhov, Yu. Ya.

ORG: none

TITLE: The stochastic nature of differentiated inhibition

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 48-49

TOPIC TAGS: man, animal, conditioned reflex, visual perception, probability

ABSTRACT: Comparative physiological study of the differentiation of visual conditioned stimuli in animals and man during simultaneous presentation of positive and negative stimuli discloses different reinforcement of the developed inhibition. In preschool children differentiation of stimuli is rapidly reinforced and remains at a level of 100% adequate reactions. In higher and lower apes differentiated inhibition appears rapidly and attains a level of 80-95% adequate reactions, but a level of 100% is rarely attained even after thousands of presentations. In brown bears and birds under similar experimental conditions, differentiation develops very slowly, is extraordinarily unstable and is often disturbed. Traditional concepts of the rigid, deterministic nature of processes of higher nervous activity do not explain the absence of 100% differentiation of sufficiently well distinguished stimuli even with prolonged training. This phenomenon, however, becomes understandable in the light of concepts about the probability nature of nerve processes (Kogan, Menitskiy, Vasilevskiy, et al.), which assign a significant role to random factors, in particular to internal and external noise. Absolute differentiation of stimuli by man can be examined as a particular case caused by the influence of a second signal system. Conditioned reflexes to absolute characteristics have very little correlation with those to relative characteristics of stimuli. At least eleven factors acting on this correlation and often functioning simultaneously were studied. Here also, a probability interaction rather than a deterministic one is present.

392.

AUTHOR: Zaripov, R. Kh.

ORG: none

TITLE: Investigation of musical compositions on computers

SOURCE: Vsesoyuznaya konferentsiya po neyrokibernetike, 3d, Rostov-on-Don, 1967. Problemy neyrokibernetiki (Problems of neurocybernetics); referaty dokladov konferentsii. Rostov-on-Don, Izd-vo Rostovskogo univ., 1967, 109-110

TOPIC TAGS: computer simulation, programmed teaching, acoustics, random process

ABSTRACT: The present work simulated musical compositions on an electronic computer using a random process limited by specific principles, and examined general principles for organization of algorithms based on hierachic levels defining different musical concepts. The simulation included composition of melodies and rhythm. The literature indicates that rhythm and melody are synthesized together according to a rhythm-melody principle, which includes a more flexible method of synthesizing the melody first, and then the rhythm. On the basis of a program for harmonization of a given melody with four-part chords which imitates the solution of practice problems in harmony, a program was constructed for analyzing solutions of problems in harmonization, fulfilling the function of the teacher. A similar program can serve as a prototype of a "teaching" program in music instruction, in particular for teaching a course in harmony.

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